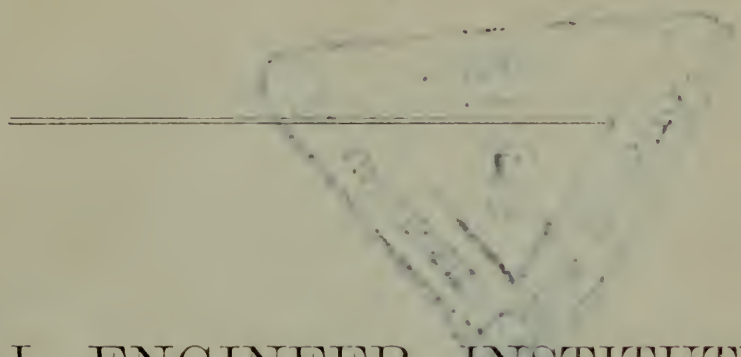
R·C

PROFESSIONAL PAPERS

OF THE

CORPS OF ROYAL ENGINEERS.



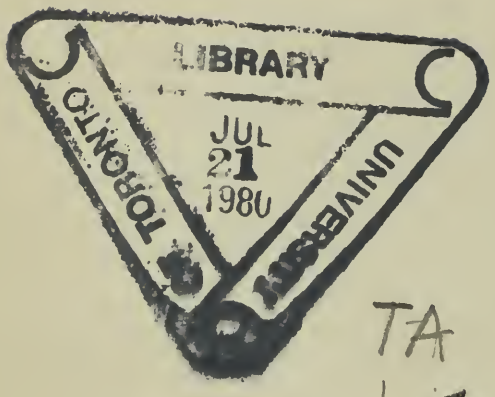
ROYAL ENGINEER INSTITUTE

OCCASIONAL PAPERS,

VOL. II.

1878.

Printed for
THE ROYAL ENGINEER INSTITUTE, AT THE S.M.E., CHATHAM.



TA
1
G72
V.2

PREFACE.

On the completion of the 2nd Volume of the New Series of the *Professional Papers*, issued in three parts (5, 6 and 7) as *Occasional Papers* during the year 1878, it seems desirable to offer a few remarks.

It will doubtless be noticed, that while the present volume contains a great deal of interesting matter connected with the primary duties of the Corps—its military duties, there is an absence of information on points of construction and civil engineering, which, considering the very large number of officers employed in India on the public works, and the importance of the works executed, not only in India and the Colonies, but also at home by Engineer Officers, is much to be regretted.

If every officer employed on works of importance would, for the sake of his brother officers, take the trouble to write an account of any part of the construction or execution of the particular work on which he may be engaged, which may be worthy of attention, and would send his observations to the Secretary of the Institute, they might find a place, according to their length and importance, either in the *Occasional Papers* or in the *R.E. Journal*, and a rich store of experience would be accumulated in our publications for the assistance and guidance of the Corps.

During the year 1878, the first two numbers have been published of a new series—*Translations*, which will be issued from time to time. This series will be bound—distinct from the *Occasional Papers*, as sufficient numbers are published to form each volume. Translations, or abstracts of translations of short pamphlets and articles will continue to appear in the *Occasional Papers*. The series of *Translations* is intended for complete works, or parts, complete in

themselves, of works of sufficient importance and length to take them out of the category of *Occasional Papers*.

In the present volume of *Occasional Papers* we have the advantage of contributions from gentlemen unconnected with the Corps, who have kindly accepted invitations from the Committee to lecture at the R.E. Institute; some of these lectures, although not treating directly on the duties of the Corps, have an indirect bearing, and their publication in our *Professional Papers* will, it is thought, be welcomed.

ROBERT H. VETCH,
MAJOR, R.E.,
Secretary, R.E. Institute.

31*st December*, 1878.

CONTENTS OF VOL. II.

No. 5.

PAPER.		PAGE.
1.	Report of the Special Commission for Experimental Firing at Shields of 55 Centimetres, at Spezzia. Translated by Lieut.-Col. Maquay, R.E., with some Notes by Captain English, R.E.	1
2.	On the Electrical Resistance of Conductors at High Temperatures, by Captain Bucknill, R.E.	17
3.	Military Use of Railways in India. *Précis* of Report of the Railway Transport Committee, India, 1876. Communicated by the Secretary R.E. Committee.	22

No. 6.

4.	The Organisation of the Imperial Russian Engineers. Translated from the German by Captain J. Gore Booth, R.E.	41
5.	On Entrenchments. By Major-General Bainbrigge, R.E. ...	63
6.	Report of General Todleben on the Investment of Plevna and Surrender of the Turkish Army, November 28th, 1877 (o.s.). Translated from the Russian by Captain G. T. Plunkett, R.E.	81
7.	The Third Battle of Plevna, September 7-12, 1877. Translated from the French by Captain G. T. Plunkett, R.E.	91
8.	Personal Equipment. By Captain T. Fraser, R.E.	105

No. 7.

9.	Armenia : Its Geography and Political Future, by J. Bryce, Esq., D.C.L	123
10.	Reminiscences of the Campaign in Armenia, by Captain H. Trotter, R.E.	145
11.	Demolition of a Factory Chimney, at Rings End, Dublin, by Major G. W. Stockley, R.E.	173
12.	The Entrenched Camp of Plevna, Translated from the French by Captain C. Woodward, R.E.	175

PAPER.		PAGE.
13.	Extract from "Instruction sur le Service de L'Artillerie dans un Siége," 1876, by Captain T. Fraser, R.E.	179
14.	Targets for the Trial of recent Heavy Ordnance, Part IV. *(to be continued)*, by Colonel T. Inglis, R.E.	185
15.	Some Recent Developments of Applied Science, by Lieut.-Col. Frank Bolton, and W. H. Preece, Esq., C.E.	203
16.	The Third Battle of Plevna, September 7-12, 1877 *(continued from page* 103). Translated from the French by Lieut. A. O. Green, R.E.	219
17.	A Letter from General Todleben to General Brialmont, on the Defence of Plevna. Translated from the French by Captain J. W. Savage, R.E.	261
18.	List of Service Ordnance and Ammunition, reprinted by permission of the Royal Artillery Institution.	

LIST OF PLATES AND TABLES.

SUBJECT OF THE PAPER.

No. of Paper.		No. of Plates and Tables.	Opposite to Page.
1.	Experimental Firing at Shields of 55 centimetres, at Spezzia, ...	4 Plates ...	16
2.	Electrical Resistance of Conductors at High Temperatures, ...	1 Plate ...	20
3.	Military Use of Railways in India, ...	5 Plates, and 9 Tables (A to J.)	40
4.	Organisation of the Imperial Russian Engineers, ...	1 Table ..	62
5.	On Entrenchments, ...	1 Plate ...	80
8.	Personal Equipment, ...	1 Table ...	122
10.	Reminiscences of the Campaign in Armenia,	1 Plate ...	172
11.	Demolition of a Factory Chimney at Rings End, Dublin, ...	1 do. ...	174
12.	The Entrenched Camp at Plevna, ...	1 do. ...	178
15.	Recent Developments of Applied Science, ...	1 do. ...	218
18.	List of Ordnance, ...	1 Table ...	270

PAPER I.

EXTRACT FROM THE REPORT OF THE SPECIAL COMMISSION FOR EXPERIMENTAL FIRING AT

SHIELDS OF 55 CENTIMETRES,

OR 21¾ INCHES,

AT THE RANGES OF MUGGIANO (SPEZIA) IN OCTOBER AND DECEMBER, 1876.*

Compiled by Cavaliere Giov: Bettòlo, Lt., Italian Royal Navy.

Translated by Lieut.-Col. Maquay, R.E., with some notes by Capt. English, R.E.

N.B.—Appendix II. of this Paper gives a detail of the rounds fired, and referred to in the Commissioners' Report.

Observations on the Effects produced on the different nature of Targets.

To arrive at the conclusions to be drawn from the results obtained at this experimental firing, it is desirable to consider the effects produced by each nature of projectile on the plates, on the structure of the targets, and on the fastenings.

Taking first the rounds fired singly by the 10-inch gun, and the two distinct types of targets, a single solid plate, and two plates with timber between them (rounds 1, 2, 3, 12, 13.)

In rounds 1, 2, and 3, (*Figs.* 1, 2, 3, *Plate* I.) against single plates, the target did not receive any sensible injury, beyond a slight deflection of the plate at the parts struck, and the shearing of some rivets of the upper waterway plate. The penetration of the projectile was less in the Schneider hammered steel, than in the rolled wrought iron plates of Marrel and Cammell; in the latter, the cracks did not extend beyond the corner bolt holes, while, in the former, they were more numerous and extensive.

In rounds 12 and 13 (*Figs.* 11, 12, *Plate* I.) against plates on the sandwich system, the effects on the structure differed but slightly

* In the R.E. Institute *Occasional Papers*, Vol. I., No. 2, Paper No. 8, will be found a description by Colonel Inglis, R.E., of the targets constructed for these experiments, and of the guns used; also, notes on the result of the practice observed on the date specified.

from those last recorded; the penetration was however greater, and the conduct of the interposed layer of timber backing was unsatisfactory, extensive disconnection of this part being observable.

Next, taking the results on the same types of targets when firing by salvos, it was observed that in rounds 4, 5, and 6 (*Figs.* 4, 5, 6, *Plate* I.) against single plates the effects of the previous rounds on the target were augmented, and a more marked deflection given to the parts struck, while the energy of the blow extended to adjacent plates whose armour-bolts were slightly elongated in their holes. The round on the Schneider plate again showed less penetration than the ones on the wrought iron plates, though it caused greater displacement of the plate, probably owing to its striking near the end of the target.

In the rounds 14 and 15 (*Figs.* 13, 14, *Plate* II.) against plates fixed on the sandwich plan, the effects of salvo fire were almost identical with those produced by the last mentioned rounds, the penetration being rather more, and the effect on the interposed timber backing being such as to destroy its usefulness as a holding medium for the armour-bolts of the back or inner plate, and of the bolts which pass through the whole structure.

Lastly, in taking note of the effect which the 100-ton gun was able to produce on the different plates with a uniform energy exerted in each case, there have to be considered the targets of single plating or solid armour, the plates in sandwich fashion, and the combinations of wrought iron plates and blocks of cast iron.

In rounds 8, 10, and 23 (*Figs.* 8, 9, *Plate* I; *Fig.* 6, *Plate* II.) against single plates of rolled iron, the projectile always perforated completely the whole structure; while in rounds 7 and 11 (*Figs.* 7, 10, *Plate* I.) against Schneider plates, these by their superior resisting power were able to absorb the amount of work the projectile could develope before it broke up, and the armour therefore protected the structure from being perforated. In all these five instances however, the plates were broken into more or less large pieces. The injury to the backing was generally localised to the parts struck. The wrought iron cup washers were usually broken, as also the armour-bolts at different points in their length, while the holding bolts (Schneider system) generally sheared at the first thread of the screwed part

which entered the plate. The structure in general was seriously shaken, and, in the Schneider plates, where the projectiles failed to make complete perforation, the back skin or inner lining plates were so fractured that fatal leakage would have occurred to a vessel struck near the water line.

In the 16th round (*Fig.* 15, *Plate* II.), against the plates on the sandwich system, the projectile in its passage through the structure caused great destruction. Pieces of the plate, the shot, the iron structure, and armour-bolts, were carried to the rear of the target. The dimensions of the breach were greater than when single plates were perforated, and the general damage more extensive.

The effect of rounds 19 and 21 (*Figs.* 3, 4, *Plate* II.), against the targets composed of wrought iron plates and cast iron blocks, may be summed up in a few words. General destruction to even a greater degree than in the sandwich target (round 16). The blocks of cast iron being violently projected out of the target against the supports at the back of the structure.

It must be remarked of all of the above described classes of targets that the effects produced on the structures would not have been so extensive if they could have been placed in precisely the same condition for resistance as the armoured sides of the "*Duilio*" and "*Dandolo*" (which the structures were intended to represent); this remark more particularly applies to the case of the structure protected by the Brown plate, which not only rested on a part of the structure already much injured by previous rounds, but the plate had besides been subjected to the blows of two projectiles of the 100-ton gun, which, though fired with a reduced charge of 240 lbs., still had an available final energy not much below 15,178 foot tons, and by one of these rounds hitting very low, the structure had been very severely tested and disturbed at its base and foundation.

The following observations were made on the nature of metal in the plates:—

The Schneider steel in all its fractures showed itself to be of a perfectly homogeneous nature of finest grain; the fibre tenacious, ductile, and of the very best quality.

Of the wrought iron plates, the Brown plate showed the most perfect welding, and was of fine and homogeneous construction.

The defects of imperfect welding were more observable in the Cammell than in the Marrel plates; the latter, however, showed a coarser and more crystalline grain.

The armour-bolt holes weaken the plates, forming lines of least resistance followed by the cracks and fissures. The system of timber backing adopted in the targets generally proved efficient; the back layer acting as a filling between the vertical ribs, and the front layer having steel stringer plates interposed horizontally between the timbers.

Remarks on Results, and Conclusions.

To consider now the matters which it was intended to enquire into by this experimental firing at Spezia:—the first point to attend to is the relative merit of single plates, and plates on the sandwich system; leaving out of the question the combinations of wrought and cast iron plates, which were unanimously condemned on account of their weak power of resistance.

From the results observed no doubt existed as to the advantage of single plates over the sandwich system. Independently of the fact that in a sandwich target subjected to moderate blows, its connections may be compromised by injury to its fastenings and the intervening material, it appeared as far as the experiments went, that two plates one over another (of equal aggregate thickness to a single plate) offer less resistance to penetration than the single plate; a shot might fail to perforate a solid plate, but it might manage to get through the outer of two plates, and where it is a question of shells, the effect of the explosion would be trifling in the solid plate as compared to what would result from a shell bursting in the backing between two plates, where it would produce the effect of a mine in the side of a ship armour-plated on this sandwich system.

Admitting that the choice falls on the single plate principle, the next question for decision is, which are the best description of plates of those produced for trial.

Three different manufacturers' wrought iron plates and the Schneider plate are for consideration. Taking in view the qualities which combine to establish the value of an armour plate, the three samples of wrought iron plates may be placed in the following order of merit: the Brown plate, the Cammell, and the Marrel.

The limit of power developed by these plates was nearly equal, although they could not resist the projectile of the 100-ton gun, while the Schneider plate was more effective under this test.

To arrive at a better comparison, the advantages and disadvantages of the wrought iron and Schneider plates as noted at these experiments, are now given.

As regards the wrought iron plates the following advantages were observed :—

1.—The damage done by a shot on these plates is more localised to the part of the surface struck.

2.—They behave better under relatively moderate blows from projectiles of ordinary artillery.

Against these the following disadvantages are apparent :—

1.—Want of continuity in the mass, derived from the difficulty of thoroughly welding and rolling plates of great thickness.

2.—A relatively lower tenacity than the Sehneider plate, and consequent less resisting power.

3.—The impossibility of preventing complete perforation in the thicknesses of plate experimented on.

The Schneider plates on the other hand show these advantages :—

1.—Greater absolute tenacity and homogeneity in the mass, more easy to obtain in the manner of their manufacture.

2.—More ready means for producing plates of such description of metal.

3.—Greater resistance to penetration, and better protection of the structure within the limit of power developed.

The following defects may, however, be imputed to these plates :—

1.—A crystalline structure, tending to brittleness, rendering the plates more liable to extensive cracks under even relatively moderate blows, and hence :—

2.—Greater readiness to break up, and thereby expose the structure they should protect.

To give full weight to the considerations of the advantages and defects recorded, to extract the real value of the comparisons made between the two natures of shields, and to arrive at a good selection of the one most competent to perform its work, it is necessary to consider what are the effects of a projectile which may result in the greatest injury to the sides of a ship.

Experience goes to prove that with massive armour plates and very powerful artillery the three following points have to be dealt with :—penetration, fracture of plate, and disconnection of structure.

If a projectile were to perforate the side of an armoured vessel, besides opening a passage for water if the hole was made near the water line, it might do serious damage to some vital part which the armour had been expressly intended to protect, and such damage would be infinitely more disastrous if a shell had passed through the side and exploded between decks. One such well-directed shot might suffice to put an ironclad out of action.

A projectile, on the other hand, which expended its work in fracturing the armour plate and in disconnecting it from the backing without perforating, might cause leaks through the inner skin; these, however, could probably be controlled, or their effect confined by the water-tight compartments of the vessel. There would be no direct injury to the internal vital parts, and though the structure would be denuded by the fracture and detachment of the plate, the probability of another shot striking in the same place is slight.

It may therefore be inferred that an armoured vessel protected by wrought iron plates, similar in quality to the best experimented on, would in all probability find itself in the condition described in the first case, if struck by a projectile possessing an energy equal to that which the 100-ton gun can develope at fighting distances; while the ship would be in the condition of the second case if it was protected by the Schneider plates similar to those which were under trial.

Further, looking at the power of the guns actually arming vessels and coast defences, it may be asserted that an ironclad will be effectually protected by either the wrought iron or the Schneider plates of the thickness of those experimented on, though the local effects on the armour would appear to be greater in the case of plates possessing the properties of steel. In this point of view it would appear preferable to select wrought iron plates, but, looking into the future, it is clear that the advantage of plates of this nature is only temporary, and such as to expose ships thus armoured presently to lose their supremacy.

Under all the preceding considerations the Commission did not hesitate to adjudge and propose as more advantageous the adoption of the single plate of the Schneider quality of metal.

One more question suggests itself, and it refers to the most effective system of fastening the armour.

Experience shows, and it is logical to admit, that the system of securing plates should have reference to their power of resistance,

The greater the number of connecting points required for the system of fastening, the more is the plate weakened by the formations of lines, or sections, of least resistance, along which the plates have a tendency to fracture. Therefore, of the two systems experimented on, it is preferable to use the Schneider plan, than the one of armour-bolts going through the whole plate. Still, in dealing with plates of steely nature, the Schneider fastenings have their disadvantages. The cavities formed in the plate act similarly to punctures in the surface of a vitrieous mass, whence originate disruption of molecules even under relatively low strains; thus a plate cannot be in the same absolute condition of resistance after the cavities have been made in it, which this system of fastening necessitate.

APPENDIX I.

Remarks on the Perforation of very Massive Plates.

If the experiments on this occasion had been specially directed to throw more light on the subject of the perforation of plates and different systems of armour structures, some valuable data might have been obtained; as it was, even the few rounds fired served to continue the study of this subject.

Although the perforations which should have been obtained were previously calculated on the formulæ of Noble and of Hélie, much value could not be assigned to these calculations, as the experiments were made against very much more massive plates than formed the basis of these formulæ; and in fact they gave higher results of perforation than were actually obtained. It must be observed however of those artillerists, that they admit in their calculations that the projectile should not be deformed or broken up in passing through the plate, while the projectiles used on this occasion always broke up. When we arrive at making the metal of shot of the heaviest guns of such a quality that it will not break up in penetrating plates, the perforations will come much nearer those to be adduced from above-named formulæ.*

* Much more in accordance with the actual results are the curves traced in *Plate* IV. by Captain English, but the theory on which these are traced is open to certain objections. English, to arrive at an equation that should represent the actual work done in penetration, submitted various samples of the wrought iron of armour plates to trials for tenacity and compression in a machine for testing materials; for tensile strength he obtained the limit

The Commission of the experimental firing at the ranges of Muggiano, anxious to derive the utmost information from the experiments entrusted to their guidance, determined to follow a course which would lead to satisfactory conclusions in establishing a formula for calculating the perforation of any plates up to thicknesses equal to those under trial.

To have obtained reliable data of the actual work required to perforate various plates, it would have been necessary to arrive progressively by many rounds at the energy required just to effect perforation; this however would have caused a deviation from the object of the experiments which was to test the resistance of the plates. It was therefore thought practicable to arrive at the same result by following another course. Besides the wire screens employed to register the initial velocity of the projectiles, other screens were placed in front of and behind the targets, to ascertain the time occupied by the shot in passing through the plate by noting the residual velocity of the projectile at its issue.

From the residual velocity at issue can be obtained the residual energy of the projectile, and this deducted from the disposable energy at time of impact, would give the energy consumed in effecting perforation; while from the time occupied by the projectile in passing through the structure may be directly deduced the velocity at impact required to effect perforation. *

Few indeed were the rounds where the complete perforation of the structures were effected, and where the residual velocity and the time occupied in passing through the plate could be observed; still the energy required just to effect perforation which was deduced by

---

of elasticity, breaking strain, and corresponding elongation, and for compression, the limit of elasticity, and the pressure necessary to produce a lateral displacement of molecules. From these experiments he deduced the energy absorbed in the tension and compression of the samples, and from the results he calculated for every foot cube of metal displaced the amount of work done to give passage to the projectile (about 4000 foot tons, 1236 kilogrammes).

He then calculated the work absorbed by friction, assuming that the resistance offered by this action was equal to the force required to shear through a section of plate, equal to the surface in contact with the projectile (23·7 tons per inch).

Adding together the two quantities of work thus found, he applied the result to ogival headed projectiles, (formed by an arc of a radius of 1½ calibres), for the depth of penetration into a solid mass of plate, and for complete perforation of a plate. Captain English then introduced the convenient equation:

$$\frac{\text{Original velocity}}{\text{Available velocity}} = \frac{\text{Weight of plate + weight of projectile.}}{\text{Weight of plate.}}$$

These calculations only apply when perforation is effected without the distortion of the shot or the plate, and in cases where the plates have no defects whatever, are of the same quality as the samples experimented on, and with perfectly hard projectile.

* To obtain the velocity at impact just necessary to perforate a plate, when the time occupied in perforation has been noted, it is required to determine the velocity of the projectile at issuing from the resisting medium.

calculation, agreed well with the actual results observed, thus almost removing any doubt which might arise from a supposition that the severing of the wires of the screen might have been caused by some fragment of plate or structure instead of by the head or by a piece of the projectile.

These few results could not form a sufficiently certain basis for analytical deductions, nevertheless they served to establish a ratio between the perforation, and the effective energy causing it which should represent a mean of the results to be used in co-ordinating these effects.

To establish, however, a formula that should represent this ratio, it was necessary to find another value for the variable quantity of the thickness of plates. To arrive at this the hits of the 10 and 11 inch guns on the plate upon plate targets were taken, selecting those where the penetration showed that just sufficient energy had been developed to perforate the front plate of 11·8 inches.

Introducing then the two values of the thicknesses 11.8 inches and 21·75 inches, and those of the corresponding energy just sufficient to go through the plates into the equation—

$$\lambda = Ks^x$$

(in which λ represent the effective perforating energy, s the thickness of the plate, K the usual experimental co-efficient) the values of K can be deduced, and of the exponent x relative to the results of the experiments.

Let s be the thickness of plate, R the resistance it offers to perforation, P the weight of projectile, V the velocity at the moment of impact, v the velocity at the moment of issue; we thus have the work absorbed by the resistance of the plate:—

$$R s = \frac{P}{2g}(V^2 - v^2) \quad \text{..... (a.)}$$

differentiating with respect to V and s, as variables, we have:—

$$\frac{P}{g} v\, dv = R\, ds$$

but in the variable motion we have $ds = v\,dt$, therefore:—

$$\frac{P}{g} v\, dv = R\, v\, dt, \text{ that is } \frac{P}{g} dv = R\, dt,$$

integrating under the hypothesis that the conditions $t = 0$, and $v = V$ are identical, we have:—

$$\frac{P}{g}\int_{v}^{V} dv = R \int_{t}^{0} dt, \text{ whence:}$$

$$Rt = \frac{P}{g}(V - v) \quad \text{..... (b.)}$$

substituting the value of R obtained from (a) we have:—

$$\frac{P}{2g}(V^2 - v^2) = s\,\frac{P(V - v)}{g\,t}, \text{ whence } t = \frac{2s}{V + v}, \text{ and } v = \frac{2s - tV}{t}$$

having thus obtained the value of v, that the velocity V_1 is just necessary to perforate a given thickness of plate s, appears as follows:—

$$\text{From (a)} \ldots\ldots \frac{P}{2g} V_1^2 = R s, \text{ but } R s = \frac{P}{2g}(V^2 - v^2)$$

$$\text{hence } V_1 = \sqrt{V^2 - v^2}.$$

According to these results it may be admitted that with single plates of a quality equal to those under trial, between the thicknesses of 11.8 and 21·75 inches, and with projectiles of a resistance or strength equal to the Palliser, the effective perforating energy may be given approximately by the equation—

$$\lambda = 0{\cdot}03498\ s^{1{\cdot}868}.$$

in which λ should be expressed in dynamodes per centimetre of circumference and s in centimetres.

By means of this formula have been traced the curves relative to the thickness of plates, and the energy sufficient for perforation (*Plate* IV.). On this same plate have been traced the analogous curves according to the formula of A. Noble, of Hélie (relative to French plates), and of English.

It may be objected that the above formula does not actually represent the exact energy necessary for perforation, but the whole energy expended, which must include the work done in the breaking up of the projectile, which occurred in every instance.

This is certainly true, but, if it is considered that in practice it is not always that the projectile passes through intact, and further, that in the supply of a quantity of projectiles it is not probable that all are of an equal degree of resistance to the samples used at experiments, it may be asserted that in practice this formula is more to be relied on than those which do not admit of the deformation or breaking up of the projectile.

Notes by Captain English, R.E.

Page 4.—In discussing the question of the relative merit of single plates, and of plates on the sandwich system, the Italian authorities appear to ignore the effect of the through joints necessary in a single plate construction.

These joints may be estimated to reduce the average effective thickness of plates like those experimented upon at Spezia by at least ten or fifteen per cent., and the effective thickness at certain points of the construction by fifty per cent.

In the sandwich system not more than half these reductions need to be allowed for.

It is considered, in this country, to be practically impossible to explode a shell with effect, under service conditions, between well arranged iron armour plates on the sandwich system; owing to the

moulds of the front plate entirely confining the fragments of the shell.

Page 6.—In discussing the question of steel as against wrought iron plates it should be borne in mind that a structure, deprived of its protection by the fracture of the armour plate and its disconnection from the backing, is vulnerable not only to another similar blow, but also to the effects of small projectiles, or even of splinters.

Page 7.—It is difficult to understand why the system of through bolting should require a greater number of connecting points than the Schneider plan.

Page 7.—It is very doubtful whether the mere breaking up of the body of the shot, without deformation, can affect the perforating power so long as the pieces keep their relative positions.

No practical difference has been found in this country between the perforating powers of chilled shot which remain entire, and of those which break into several pieces.

As long as the pieces remain cold after impact, and the fractured surfaces are not distorted, it is difficult to see how any appreciable amount of work can be done in breaking up the shot.

APPENDIX II.

DETAIL OF 24 ROUNDS FIRED AT THE RANGES OF MUGGIANO, NEAR SPEZIA, IN OCTOBER AND DECEMBER, 1876, AGAINST 21¾-INCH PLATES.

No. 1.—10-*Inch Gun against Schneider plate of* 21¾ *Inches.*

Two fractures were made across the plate, and a third one diagonally across, all radiating from the point of impact, and extending through the whole thickness of the plate. These fractures become more marked some time after the firing. *Fig.* 1, *Plate* I.

No. 2.—10-*Inch Gun against the Cammell plates of* 21¾ *Inches.*

From the holes of the armour bolts at the side of the plate towards the upper and lower corners two fissures *a c* were produced: the first through the whole thickness of the plate. The plate was displaced ·59 inches to the rear, measured from the nearest point from the centre of percussion; producing an equivalent compression of the timber backing. *Fig.* 2, *Plate* I.

No. 3.—10-*Inch Gun against the Marrel plate of* 21¾ *Inches.*

The projectile remained embedded in the plate with its ogival point broken up. A crack was made in the plate from the lower armour-bolt *a*, towards its lower edge *c c*. *Fig.* 3, *Plate* I.

No. 4.—11 *and* 10-*Inch Guns against the Schneider plate of* 21¾ *inches.*

The right side of the plate was struck, and a piece carried away; this produced an extension of the diagonal fracture caused by the previous shot on the plate. The holding bolt *a* was torn away, and twisted by the detached piece of plate. *Fig.* 4, *Plate* I.

No. 5.—11 *and* 10-*Inch Guns against Cammell plate of* 21¾ *inches.*

The projectile of the 10-inch gun struck the lower armour-bolt on the right, producing a fracture of the plate, and completely detaching a piece. Another piece was detached, and bedded into the backing.

The projectile from the 11-inch gun remained imbedded in the plate, causing a fracture from the upper armour-bolt hole to the upper edge of the plate, extending through the whole thickness of the plate. The fracture shows a rather coarse homogeneous grain, and two very distinct laminar planes or welds.

The front layer of wood backing suffered a slight deformation. *Fig.* 5, *Plate* I.

No. 6.—11 *and* 10-*Inch Guns against Marrel plate of* 21¾ *inches.*

As in the previous two cases the salvo-fire was directed against the right side of the plate.

The piece H was knocked out of the target, the plate at K was fractured, and a piece was detached from the part marked M. The upper armour-bolt was driven in and bent 3·9 inches to the right. The corner armour-bolt was completely embedded into the timber backing.

The fracture of the plate was coarse grained, crystalline, and not very homogeneous, and showed traces of eight laminar beds, three of which were very distinct, 6·6 inches, 10·7 inches, 17·9 inches from the surface of the plate. The timber backing was slightly injured by the action of the pieces of plate disturbed and detached. *Fig.* 6. *Plate* I.

No. 7.—100-*Ton Gun against the Schneider plate of* 21¾ *inches.*

The shot pierced the plate, lodged in the backing, and broke up into fragments. The plate was split into several pieces; except the piece E which remained attached by a holding bolt, the whole left half of the plate ABCD was thrown out of the target. The pieces L and M only held on by the holding-bolts, which were partly torn out of the structure and twisted. All the bolts except those holding the pieces of plate FGH were broken, driven back and twisted. The

backing was shattered where the shot penetrated, and split up and disconnected on all the right side of the target. On the left side, where the plate was only split, not much damage was done to the backing.

The fracture of the plate shows fine grain, and appears perfectly homogeneous.

The beams forming the foundation of the target were driven down into the ground about 11·8 inches. *Fig.* 7, *Plate* I., and *Fig.* 1, *Plate* III.

No. 8.—100-*Ton Gun against Cammell plate of* 21¾ *inches.*

The projectile perforated the whole structure, making a breach of almost 3 feet in the backing. The right half of the plate was thrown out of the target, breaking all the armour-bolts. The fracture of the plate shows a rather coarse grain of iron in eight laminar beds. The back layer of the backing does not seem to have suffered much injury except where the shot passed through.

The back skin of the structure was split for its whole height between the sixth and seventh ribs where the shot struck, and the ribs themselves, as in the preceding round against the Schneider plate, were damaged. *Fig.* 8, *Plate* I., and *Fig.* 2, *Plate* III.

No. 9.—100-*Ton Gun against the structure between the plates of the right hand target.*

The shot broke up at the muzzle, the ogival head struck the backing between the plates, piercing the structure, and deviating to the left. This piece of the head perforated the back skin making a round hole of 33 inches in diameter, split the timber baulk supporting the deck beam and embedded itself 13 feet in the screen at the back into the second tier of gabions.

The weight of this fragment of the head of the projectile producing the above effects was 380 lbs. *Fig.* 3, *Plate* III.

No. 10.—100-*Ton Gun against Marrel plate of* 21¾ *inches.*

The plate was reduced to fragments; only a piece A was left attached by an armour-bolt, and that was split in two through the bolt hole, and detached from the timber backing. All the armour-bolts were torn away, twisted, or set back. The backing was completely pierced by the projectile, and the double back skin rent asunder between the sixth and seventh ribs. *Fig.* 9, *Plate* I., *Fig.* 4, *Plate* III.

No. 11.—100-*Ton Gun against Schneider plate of* 21¾ *inches.*

With the exception of the pieces A and B the plate was broken up into fragments, and detached from the target. The lines of

fracture *abcd* were those produced by the first round. The holding bolts were all bent or broken at the first thread of the screw where it enters the plate. The ogival head of the shot remained imbedded in the timber backing. *Fig.* 10, *Plate* I., and *Fig.* 5, *Plate* III.

No. 12.—10-*Inch Gun against Cammell plates* 11·8 *inches* + 9·8 *inches on the Sandwich system.*

The shot perforated the first plate of 11·8 inches, bedding its point 1·5 inches into the back plate, and slightly bulging the back skin which it did not reach. *Fig.* 2, *Plate* I.

No. 13.—10-*Inch Gun against the Marrel plates of* 11·8 *inches* + 9·8 *inches on the Sandwich system.*

A splinter of the projectile detached some pieces of the timber backing in the top corner, and tore off 16 feet of the iron plate crowning the backing.

The front plate was split. The fracture shows the grain of iron to be homogeneous and rather coarse, and with a laminar seam very distinctly marked almost in the middle of the plate. *Fig.* 12, *Plate* I.

No. 14.—*Guns of* 11 *and* 10 *inches in salvo against Marrel plates of* 11·8 *inches* + 9·8 *inches on the Sandwich system.*

The ogival heads of the projectiles which broke up remained embedded in the target. The part of the front plate to the right of the points of impact was broken in several pieces.

The fragment of the front plate marked C was bent back on the armour-bolt *a*. The armour-bolt *b* was slightly bent downwards, and the fragment D remained suspended by it.

The fracture of the plate, showed a coarse and crystalline grain, and five equi-distant laminar seams were observable. *Fig.* 13, *Plate I.*

No. 15.—*Guns* 11 *and* 10 *inches against the Cammell plates* 11·8 *inches* + 9·8 *inches on the Sandwich system.*

The backing was much damaged over all the part struck by the shots.

The fracture of the front plate shows five laminar seams or welds in its thickness. *Fig.* 15, *Plate* I.

No. 16.—100-*Ton Gun against Marrel plates of* 11·8 *inches* + 9·8 *inches on the Sandwich system.*

The projectile went through the target, completely destroying it; for a space of 5 feet round the hole formed everything was split up and shattered. The front plate was broken up, and the front layer of backing rent into three pieces. The back plate was perforated

and the back layer of timber backing detached. The back skin was broken up for a space of 18 feet square ; the three first ribs on the left were twisted, and one of the deck beams damaged.

Pieces of plate, timber backing, and of shot were projected to the rear as far as the foot of the screen placed to catch splinters. *Fig.* 15, *Plate* I., *Fig.* 6, *Plate* III.

No. 17.—100-*Ton Gun against Cammell plates of* 11·8 *inches* + 9·8 *inches on the Sandwich system.*

The projectile broke up in the plate. The front plate was split up in the lines *ab*, *cd*, *ef*. Though the fracture *ab* seems attributable to the penetration of the projectile, those at *cd* and *ef* would appear to have been caused by the yielding of the plate to the impact of the shot, this is inferred from the fractures *cd*, *ef* being more open at the back of the plate than on its face. *Fig.* 1, *Plate* II.

No. 18.—100-*Ton Gun against the Brown plate of* $21\frac{3}{4}$ *inches.*

The projectile struck on the lower edge of the plate to the right of the armour-bolt *a*, leaving the impress of the ogival head, the upward yielding of the plate deflected the shot into the ground, injuring the base or foundation plate. The base plate was detached from the timber backing for a length of 13 feet by the drawing of the wood screws.

The armour-bolt hole *a* was completely obliterated by the burring up round the edge of the shot hole. The foot of the structure was set back, displacing the cross and horizontal beams of the base of the structure.

The left side of the plate felt the shock most, where the top corner K sprung out 7 inches beyond the bottom corner. *Fig.* 2, *Plate* II.

No. 19.—100-*Ton Gun against a plate of Marrel iron in contact with cast iron blocks;* 7·8 *inches* + 13·6 *inches of metal.*

The projectile completely perforated the target making a clean hole of 13 inches without any cracks or fissures, and completely destroying for a radius of 3 feet the two layers of timber backing, and the blocks of cast iron composing the back of the target. The breach made in the back skin measured nearly 6 feet square. *Fig.* 3, *Plate* II.

No. 20.—100-*Ton Gun against same target.*

The projectile broke up close to the muzzle of the gun, the largest piece of it striking the ground half way to the target, and in its ricochet struck the right hand target sideways where there was only one layer of backing.

No. 21.—100-*Ton Gun against a Marrel plate with cast iron blocks* 7·8 *inches* + 13·6 *inches of metal.*

The whole structure was perforated by the shot. All the part loosened of the front plate was thrown out of the target. The armour-bolts *c* and *d* were broken, and bedded into the backing, the bolt *a* was elongated in its hole, and projected 7 inches.

The fracture of the front plate was of homogeneous fine grain, with no traces of laminar welds. *Fig.* 5, *Plate* II.

No. 22.—100-*Ton Gun against the Brown plate of* $21\frac{3}{4}$ *inches.*

The ogival head of the shot remained embedded in the plate, splitting the plate in the line *mn*, and bending the plate into the backing. This deflection commences from the armour bolt *d* on the right, and measures 5·3 inches at the upper corner B, and 10·5 inches at the lower corner A on the left edge of the plate. The effect was to elongate the bolts *a b c d* and make them project from the surface.

The depression of the plate extended through the backing bulging out the back skin.

Other parts of the plate were in no wise injured. The fracture shows a fine crystalline grain, and two laminar welds one 10 inches, the other 16·7 inches from the front surface, the iron appearing of good quality. *Fig.* 6. *Plate* II.

No. 23.—100-*Ton Gun against the Brown plate of* $21\frac{3}{4}$ *inches.*

The projectile went through the whole structure. The part of the plate detached on the right was moved in one piece, and thrown 17 feet to the side. In the part struck the backing was damaged the whole height of the plate. The fracture of the plate presented the same appearance as noted in the last round, except that the welds were 14·8 inches and 13·2 inches from the face of the plate. *Fig.* 7, *Plate* II.

No. 24.—100-*Ton Gun against the Brown plate of* $21\frac{3}{4}$ *inches.*

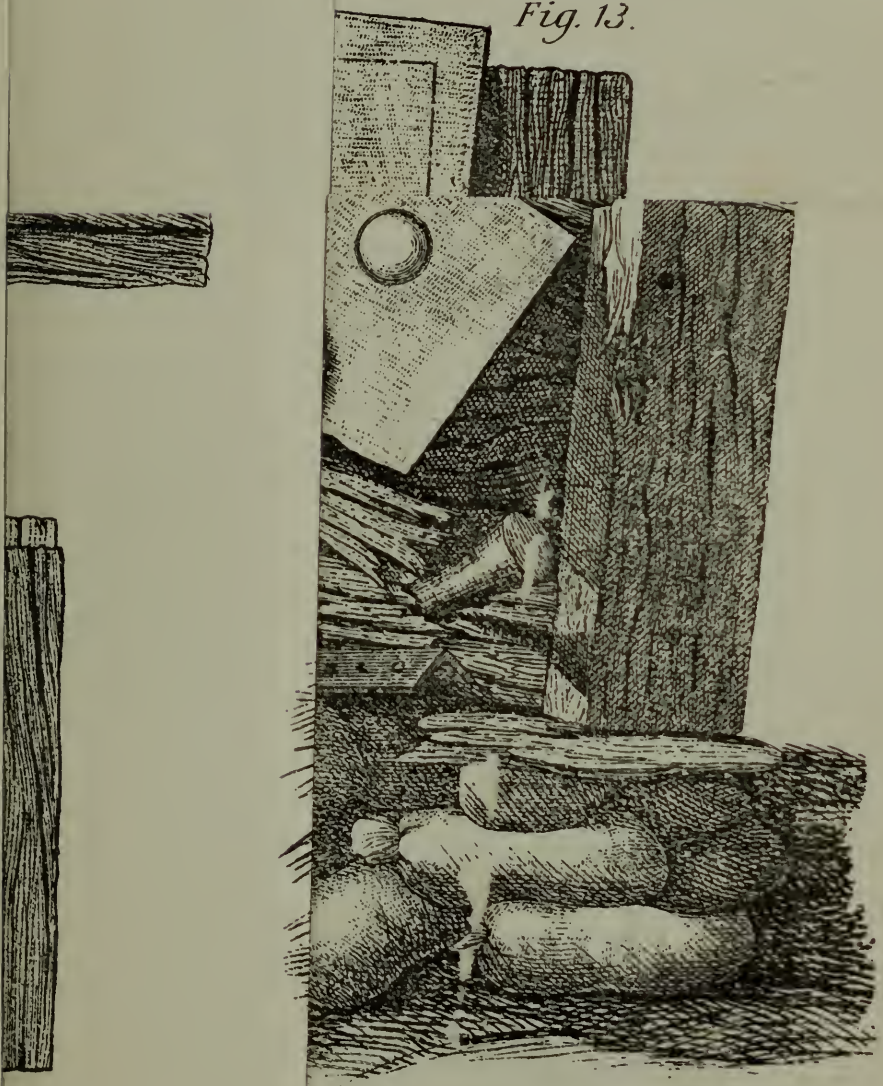
This shot was aimed against the central part of the plate, which remained in position after the last recorded rounds.

The part A B C D was thrown out of the target, leaving the armour-bolt *a* in its place. From want of resistance in the structure, already damaged by previous rounds, the plate was set back 16 inches. This presented three distinct welds, the first 5·4 inches, the second 3·1 inches, and the third 7·8 inches from the front face. *Fig.* 7, *Plate* II.

PLATE I.

EM)

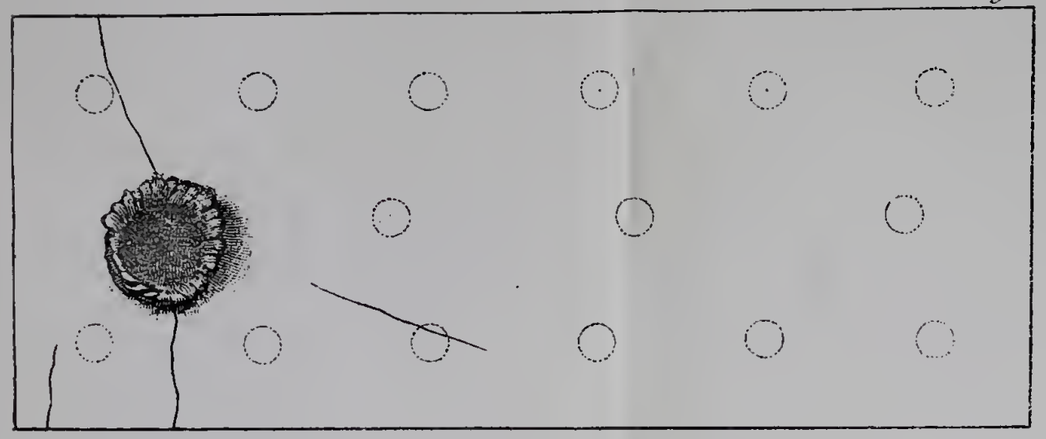
Fig. 13.



(RIGHT TARGET)

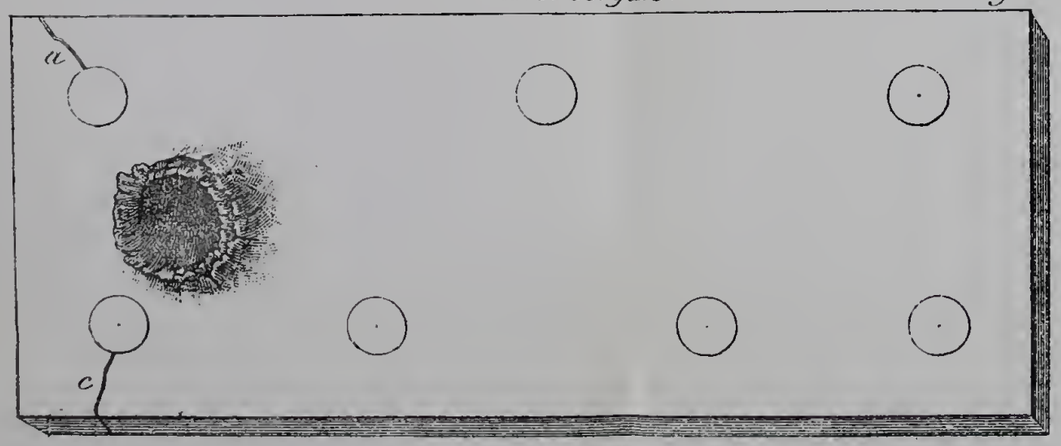
SCHNEIDER PLATE

1st round with 10 in. guns. *Fig. 1.*



CAMMELL PLATE

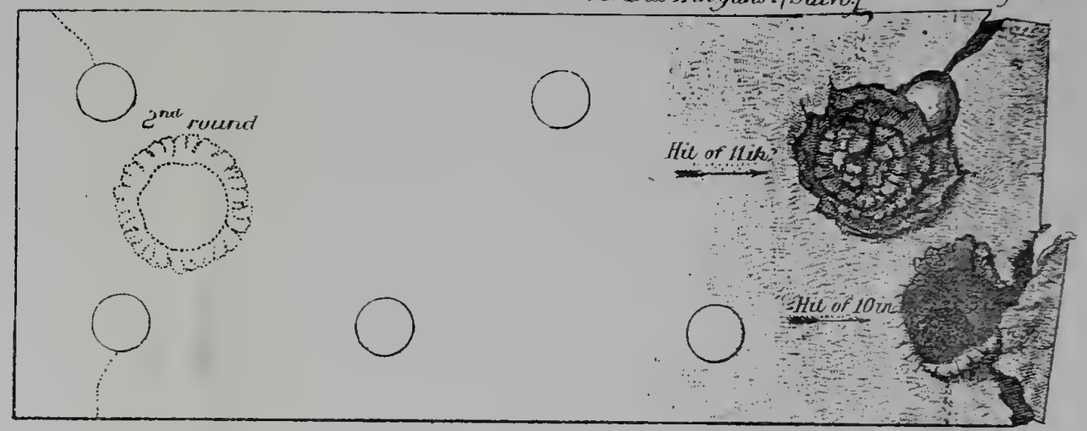
2nd round with 10 in. gun. *Fig. 2.*



"DUIL

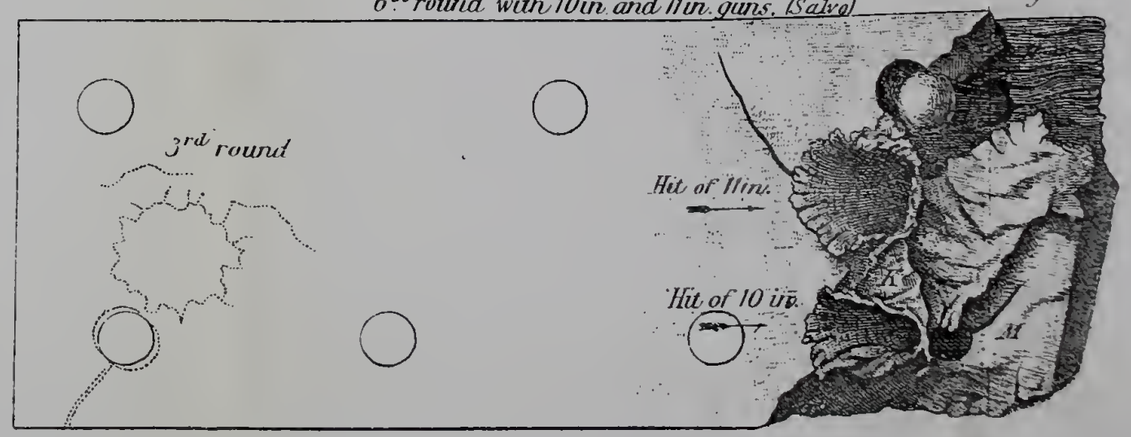
CAMMELL PLATE

5th round with 10 in. and 11 in. guns. (Salvo.) *Fig. 5.*



MARREL PLATE

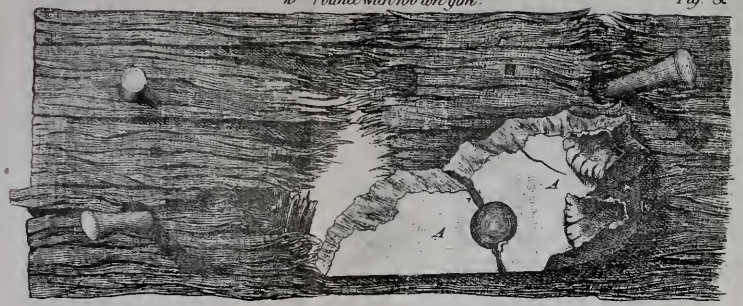
6th round with 10 in. and 11 in. guns. (Salvo) *Fig. 6.*



"DUILIO" TYPE OF TARGET

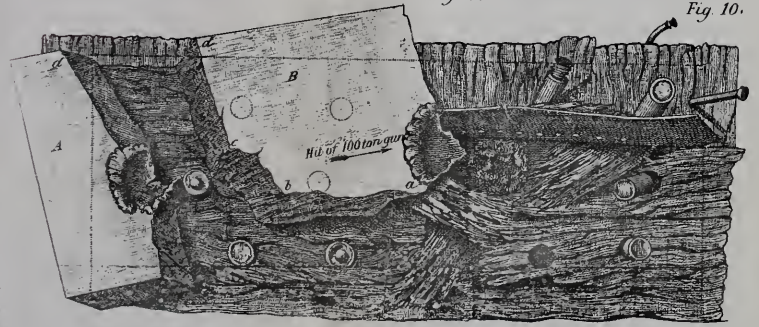
MARREL PLATE

10th round with 100 ton gun. Fig. 9.



SCHNEIDER PLATE

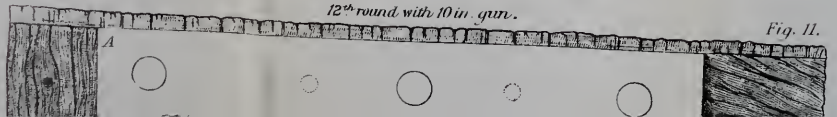
11th round with 100 ton gun. Fig. 10.



(LEFT TARGET)

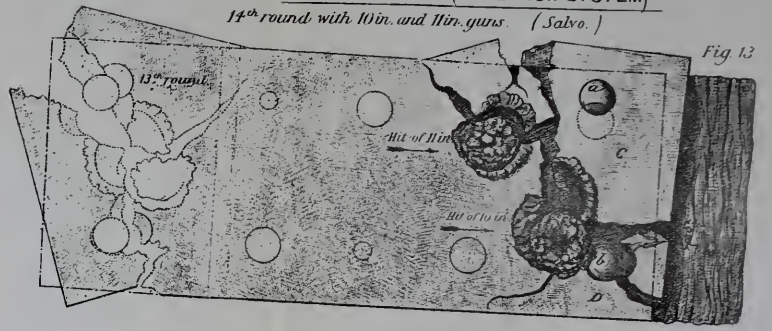
CAMMELL PLATES (SANDWICH SYSTEM)

12th round with 10 in. gun. Fig. 11.



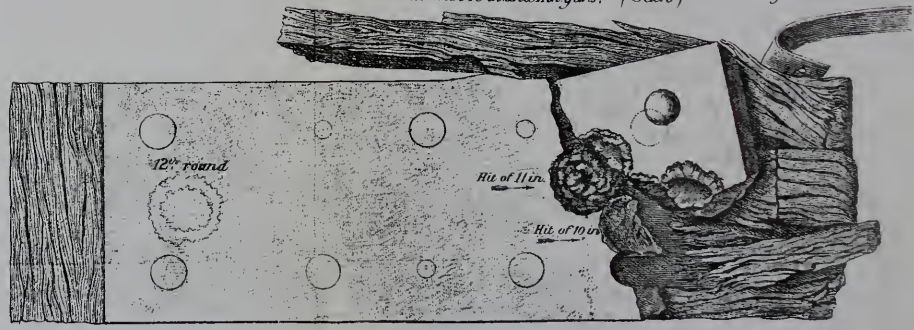
MARREL PLATES (SANDWICH SYSTEM)

14th round with 10 in. and 11 in. guns. (Salvo.) Fig. 13.



CAMMELL PLATES (SANDWICH SYSTEM)

15th round with 10 in. and 11 in. guns. (Salvo.) Fig. 14.

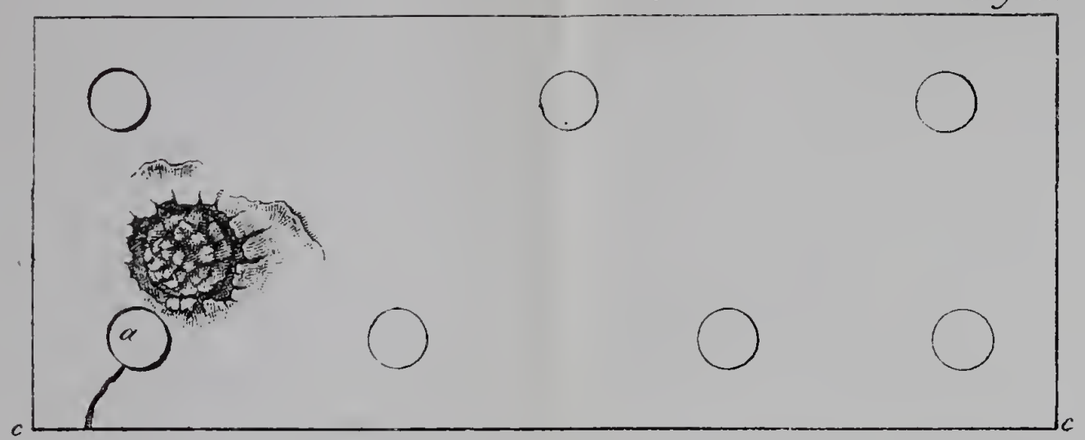


MARREL PLATES (SANDWICH SYSTEM)

MARREL PLATE

3rd round with 10 in. gun.

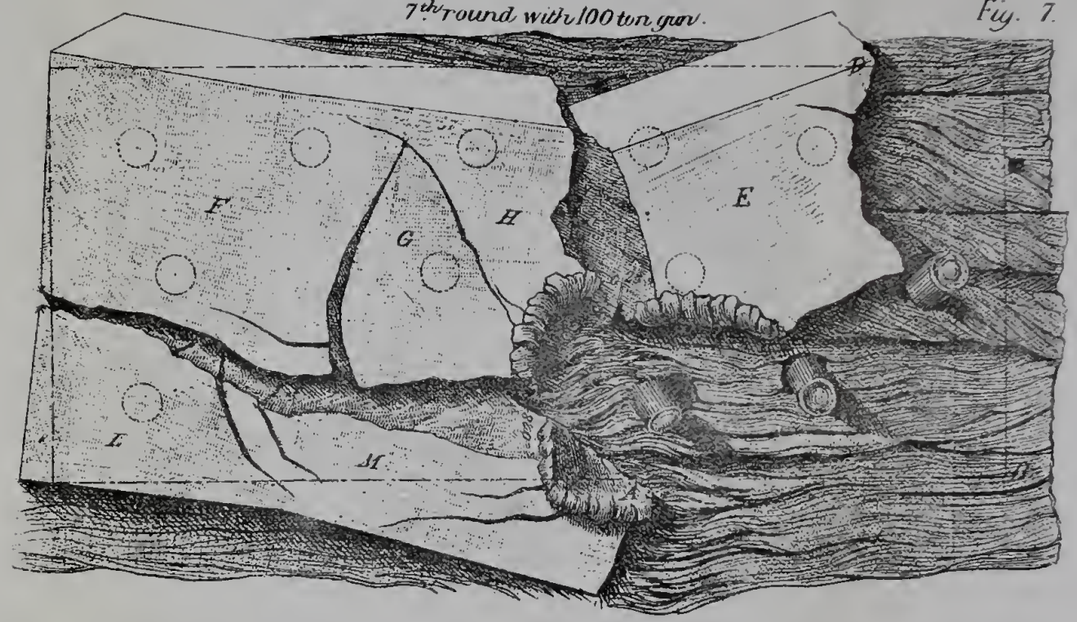
Fig. 3.



SCHNEIDER PLATE

7th round with 100 ton gun.

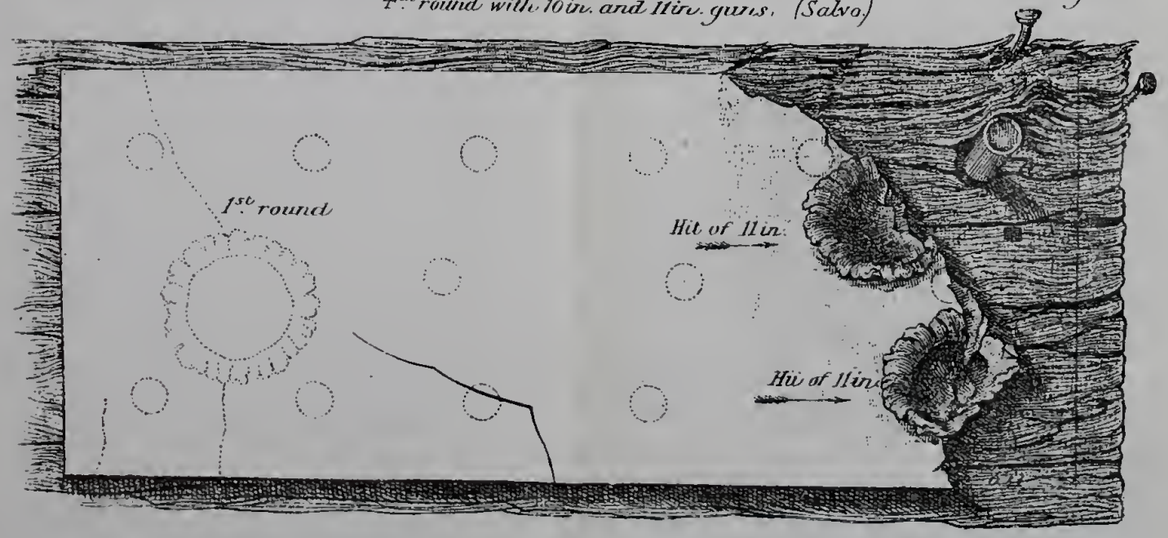
Fig. 7.



SCHNEIDER PLATE

4th round with 10 in. and 11 in. guns. (Salvo)

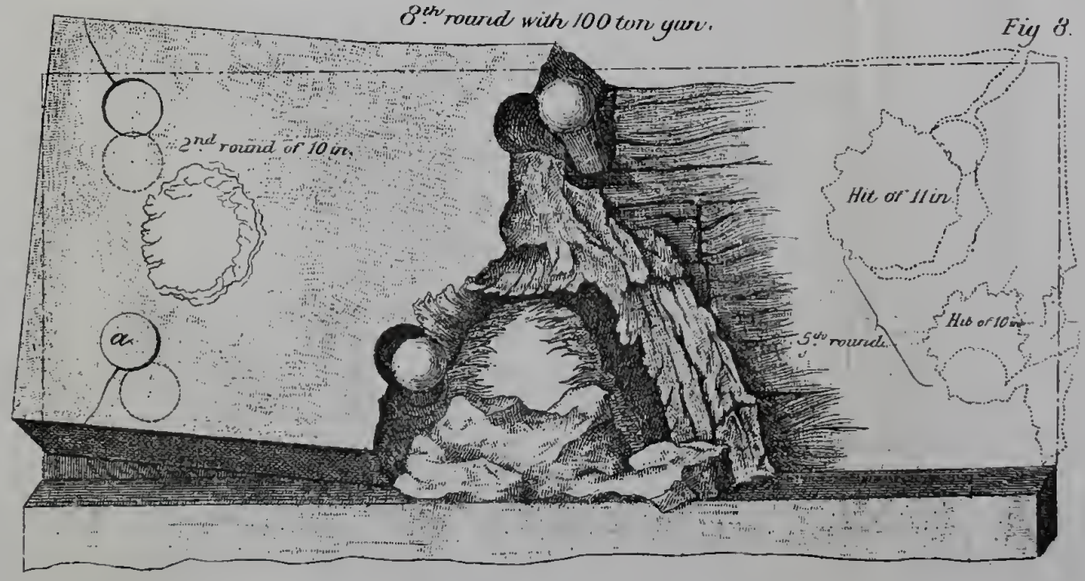
Fig. 4.



CAMMELL PLATE

8th round with 100 ton gun.

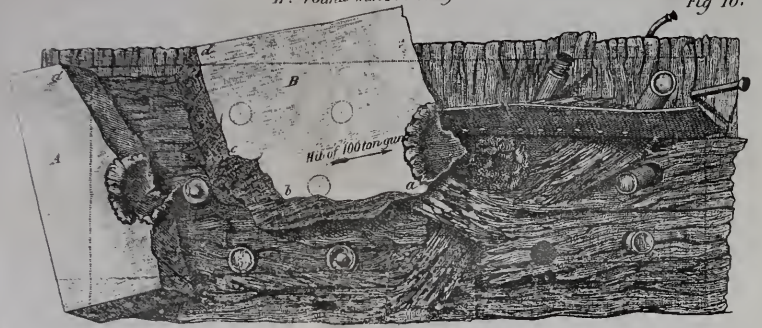
Fig 8.



Papyrotype S.M.E. Chatham.

11th round with 100 ton gun.

Fig 10.

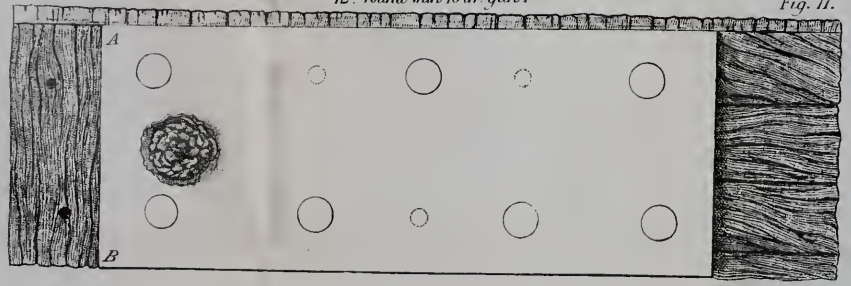


(LEFT TARGET)

CAMMELL PLATES (SANDWICH SYSTEM)

12th round with 10 in gun.

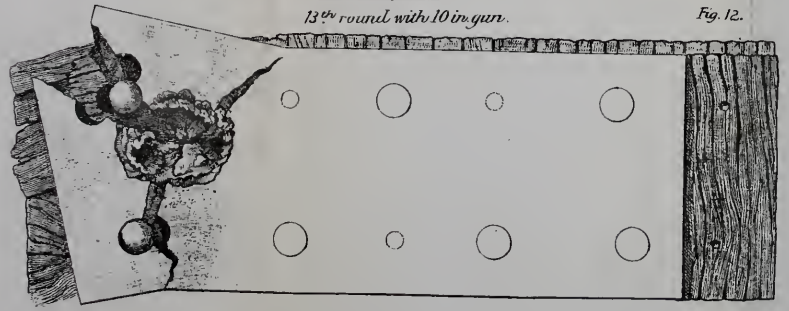
Fig. 11.



MARREL PLATES (SANDWICH SYSTEM)

13th round with 10 in gun.

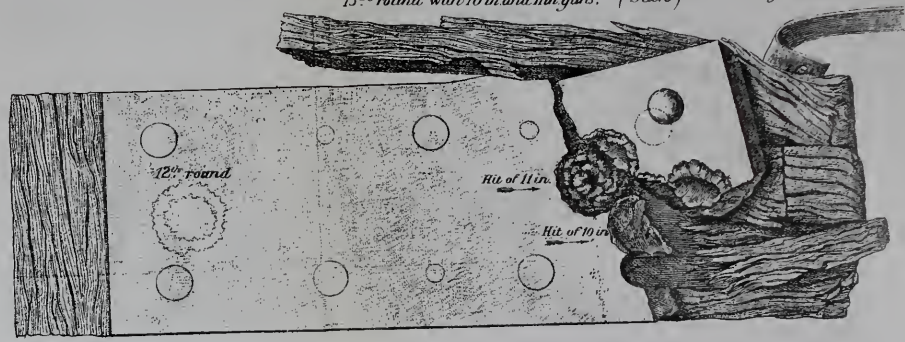
Fig. 12.



CAMMELL PLATES (SANDWICH SYSTEM)

15th round with 10 in and 11in guns. (Salvo)

Fig 14.



MARREL PLATES (SANDWICH SYSTEM)

16th round with 100 ton gun.

Fig. 15

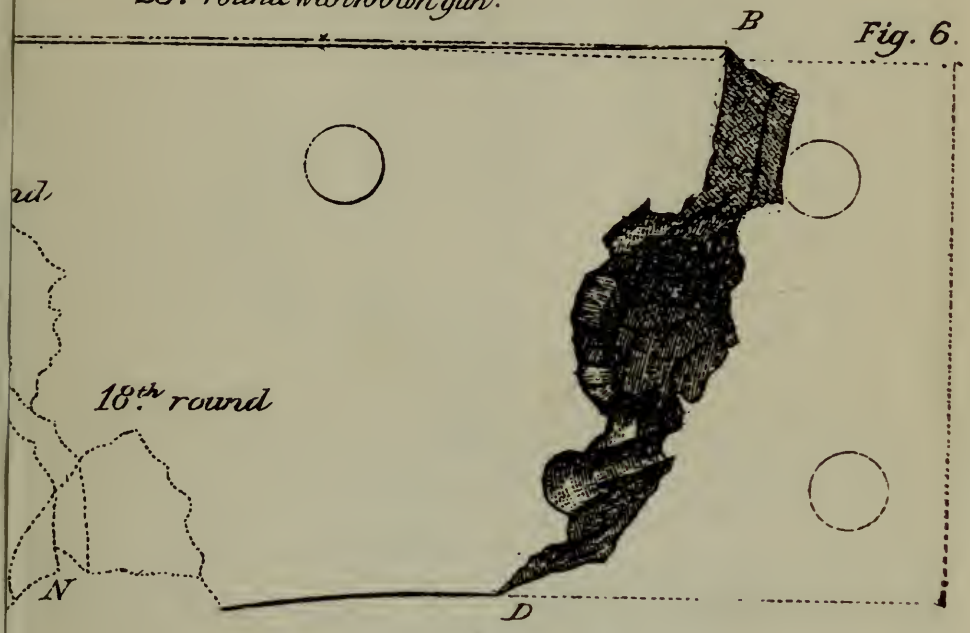
(LEFT TARGET)

BROWN PLATE

PLATE II.

23rd round with 100 ton gun.

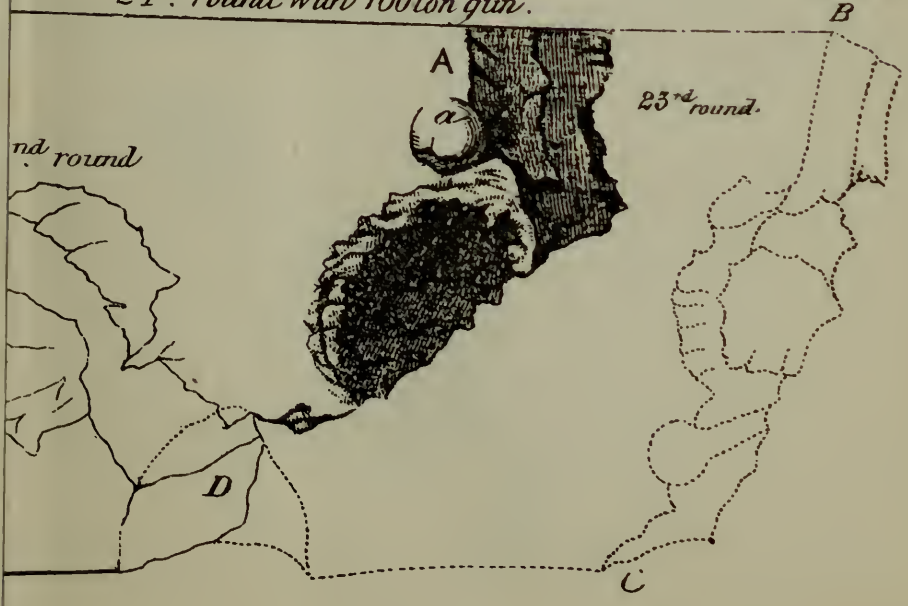
Fig. 6.



BROWN PLATE

24th round with 100 ton gun.

Fig. 7.



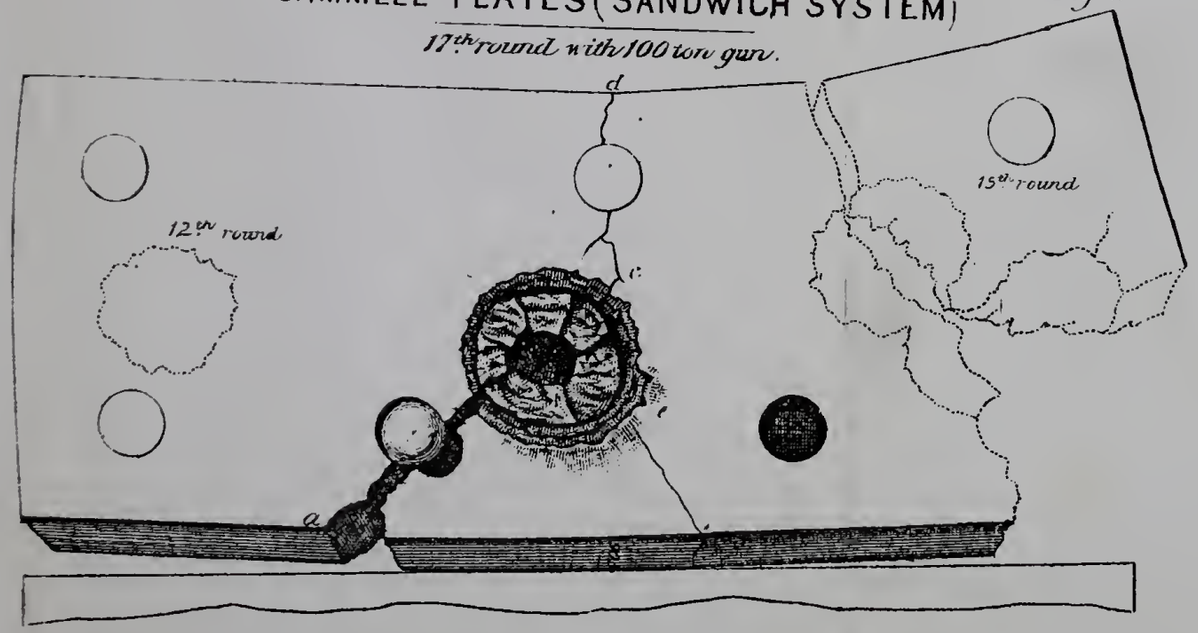
"DUILIO" TYPE OF TARGET

(LEFT TARGET)

CAMMELL PLATES (SANDWICH SYSTEM)

17th round with 100 ton gun.

Fig. 1.

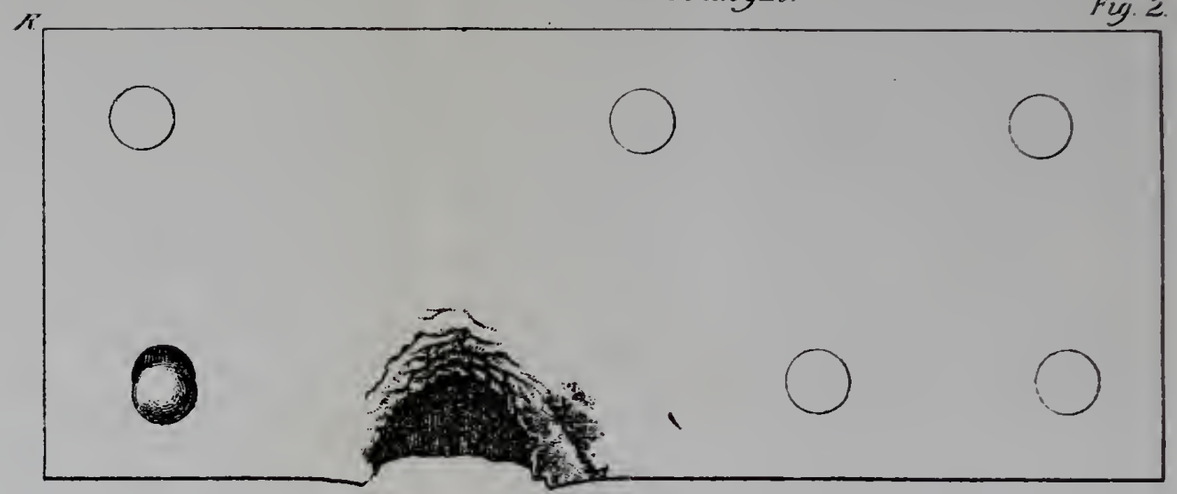


(LEFT TARGET)

BROWN PLATE

18th round with 100 ton gun.

Fig. 2.

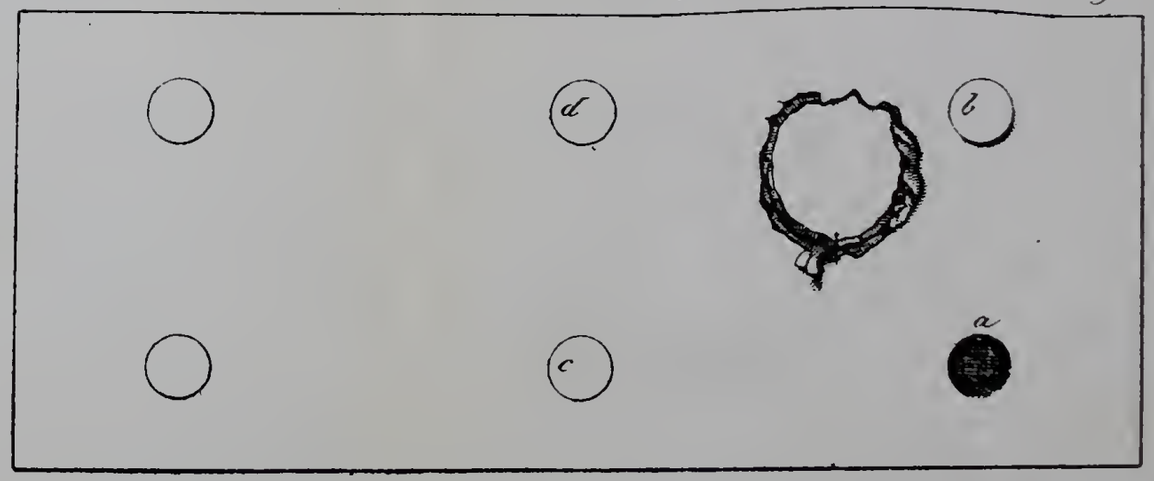


(RIGHT TARGET)

MARREL PLATE (AND CAST IRON BLOCKS)

19th round with 100 ton gun.

Fig. 3

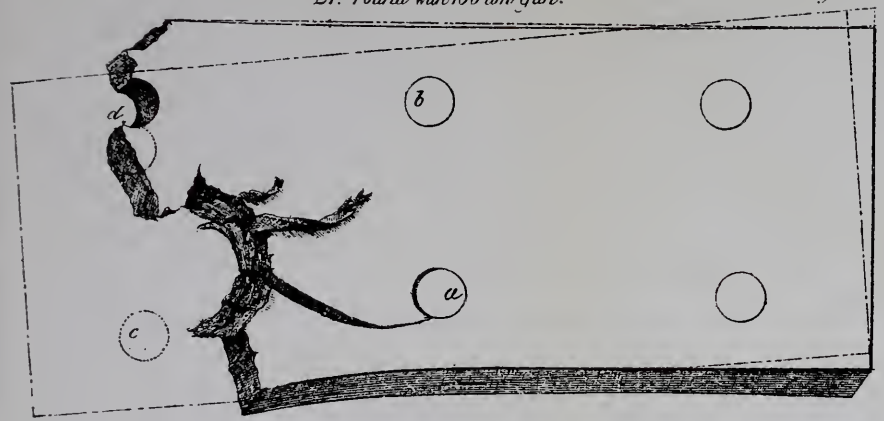


(RIGHT TARGET)

MARREL PLATE (AND CAST IRON BLOCKS)

21st round with 100 ton gun.

Fig. 4

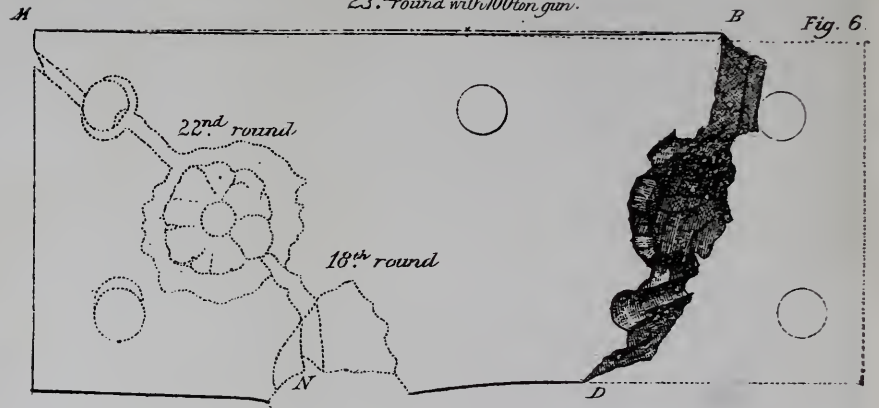


(LEFT TARGET)

BROWN PLATE

23rd round with 100 ton gun.

Fig. 6.

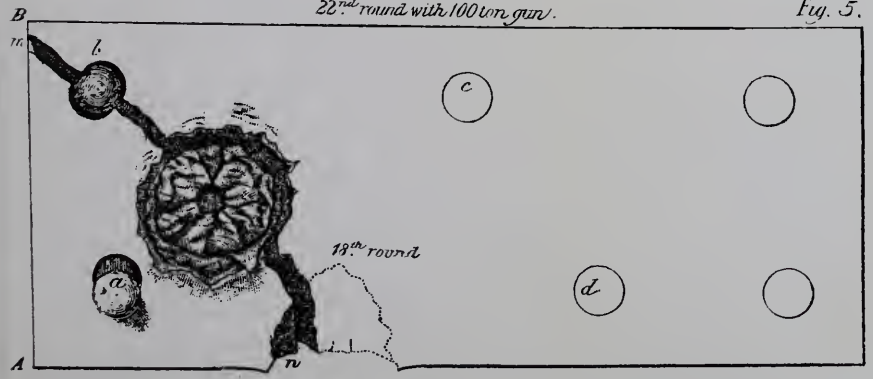


(LEFT TARGET)

BROWN PLATE

22nd round with 100 ton gun.

Fig. 5.



BROWN PLATE

24th round with 100 ton gun.

Fig 7.

PLATE III.

Fig 6.

(LEFT TARGET)

th round with 100 ton gun against Marrel Plate (Sandwich System)

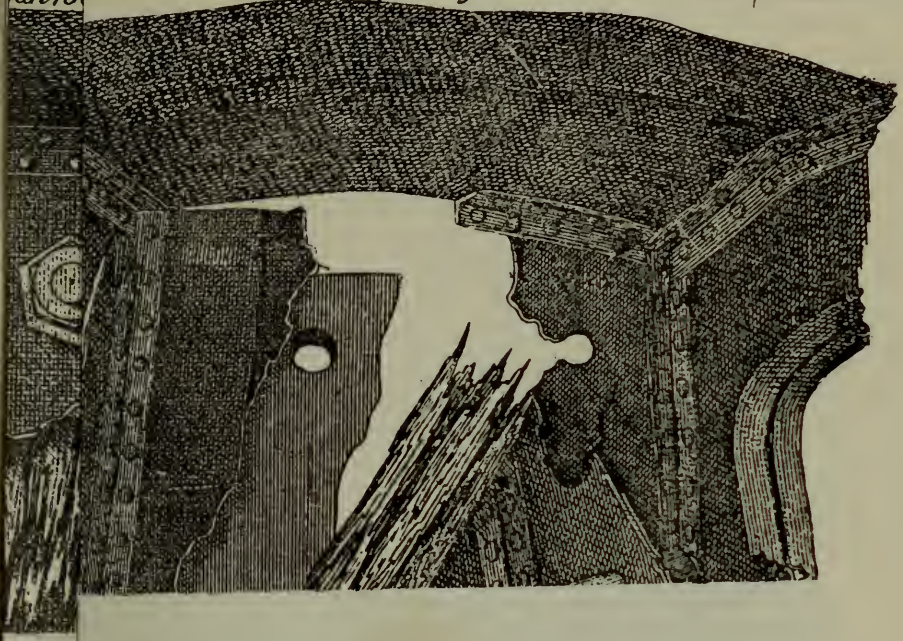


Fig. 1.

7th round with 100 ton gun, against Schneider Plate.

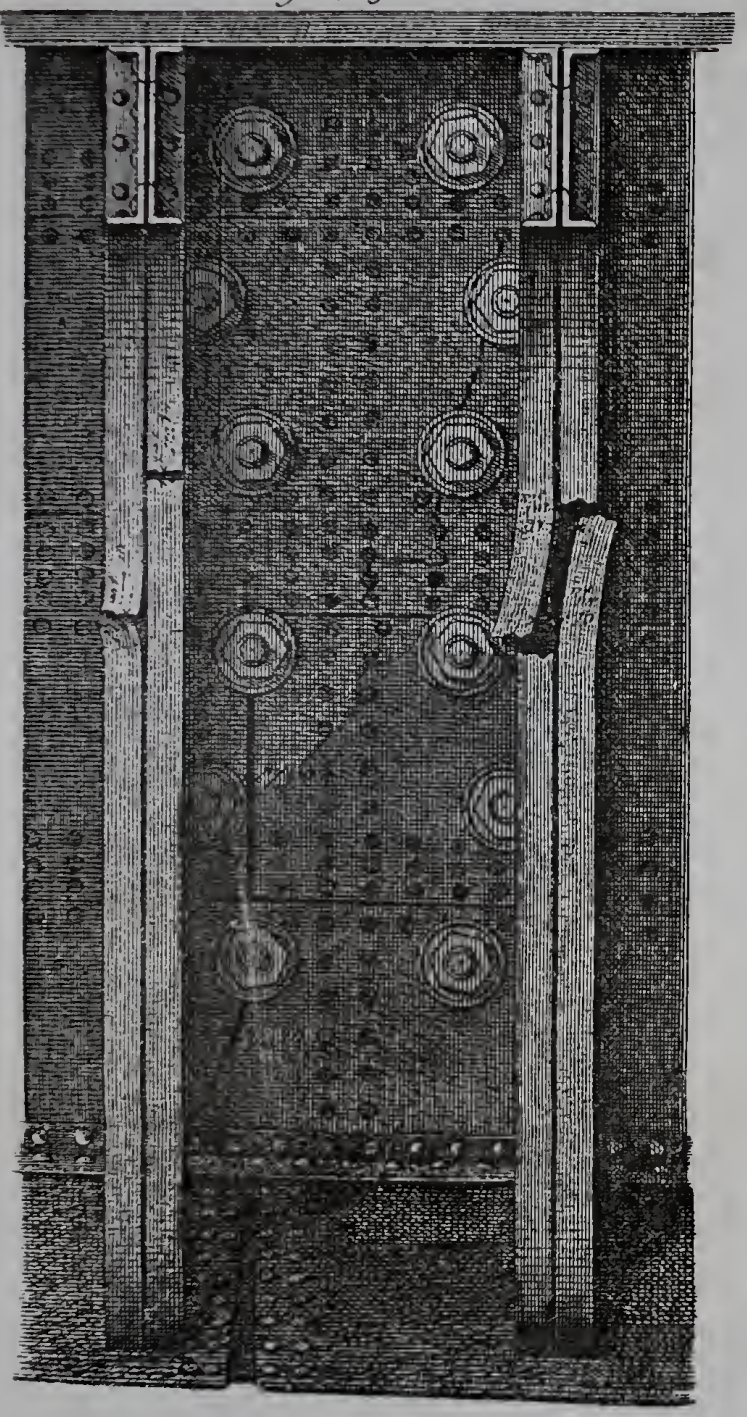


Fig. 2.

(RIGHT TARGET)

8th round with 100 ton gun against Cammell Plate.

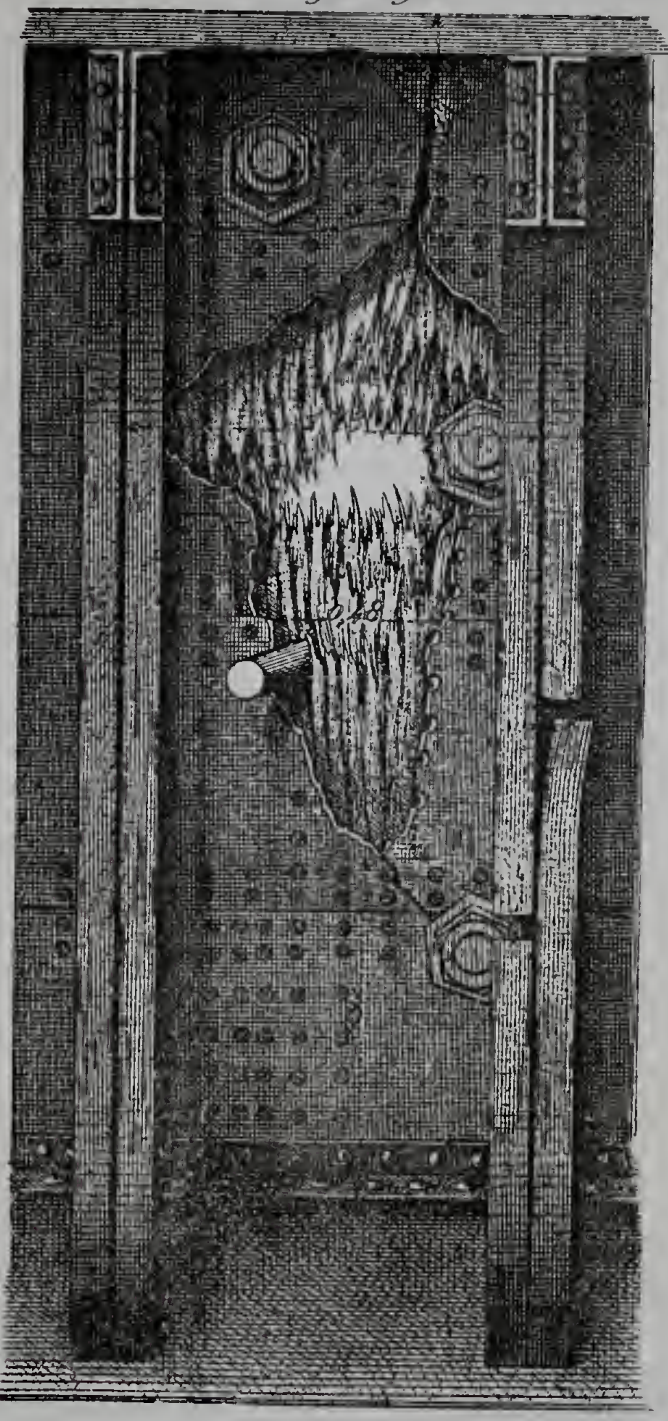
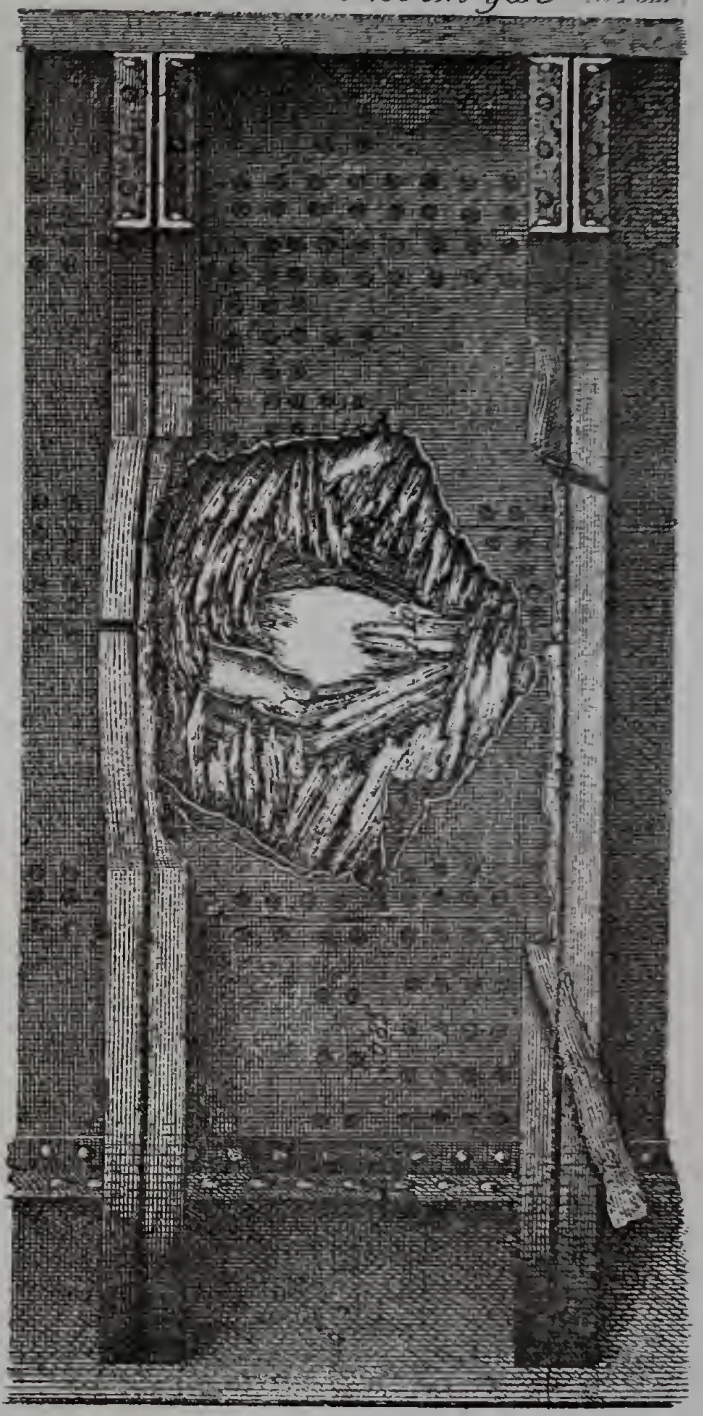


Fig. 3.

9th round with 100 ton gun (No Plate)



"DUILIO" TYPE OF TARGET

Fig 4
(RIGHT TARGET)
10th round with 100 ton gun against Marrel Plate.

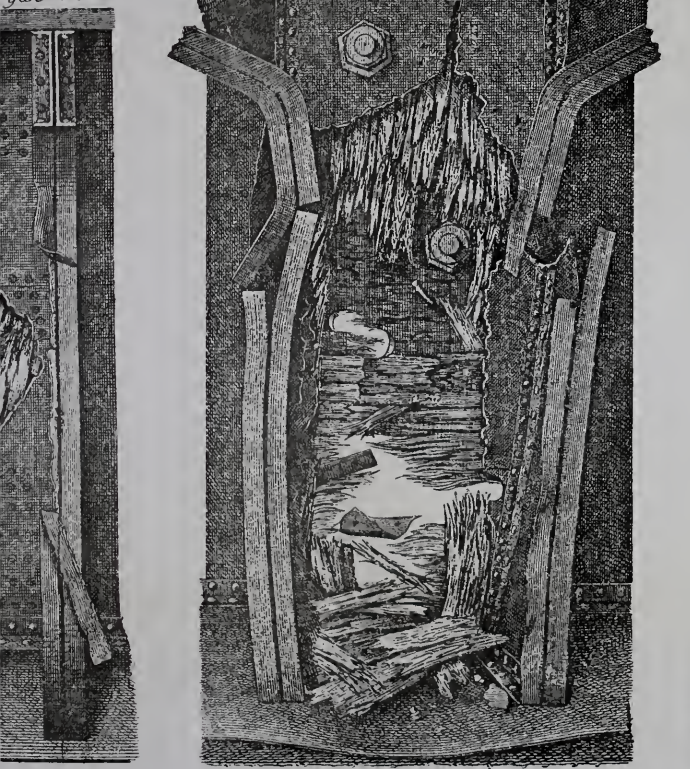
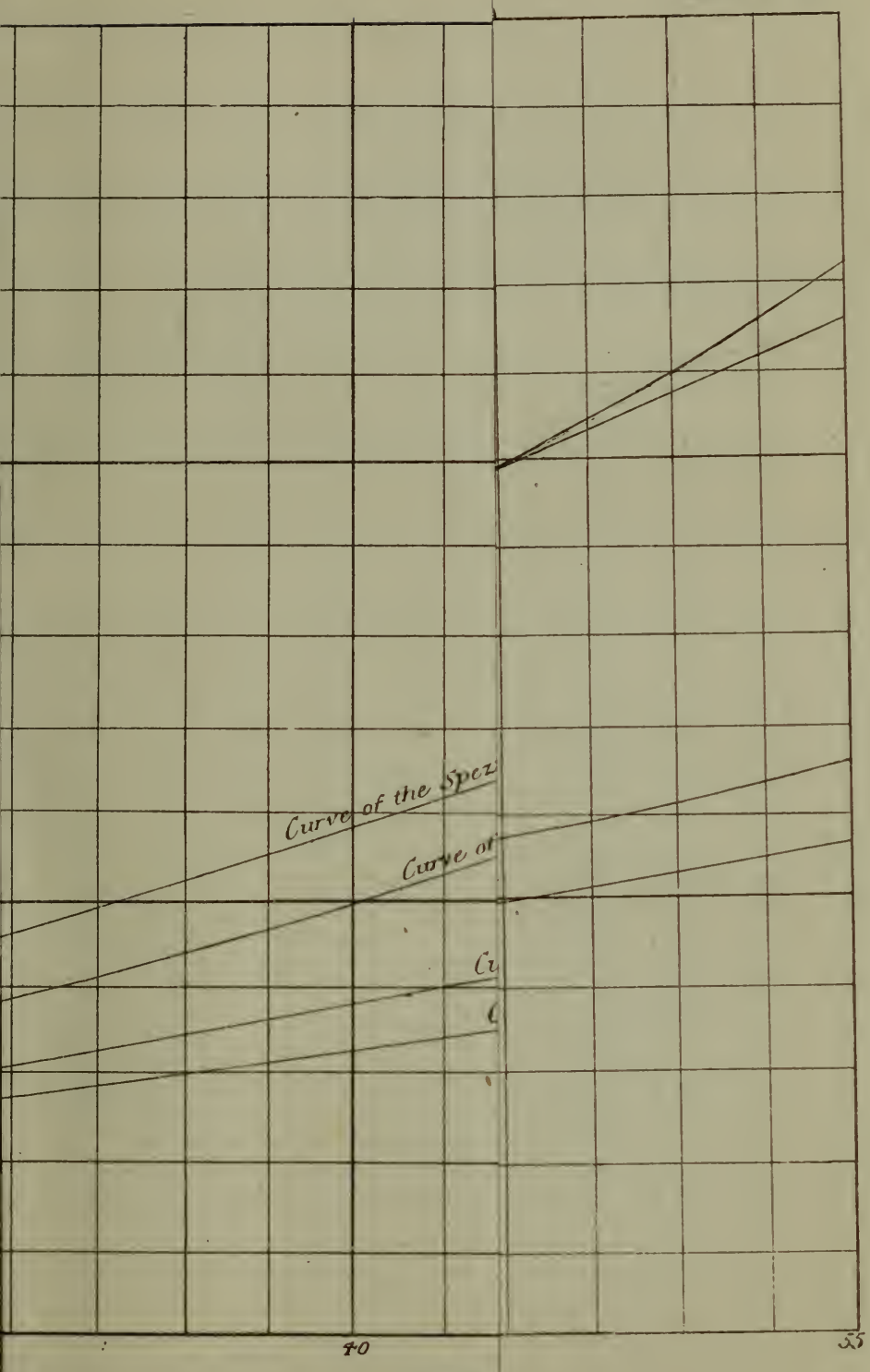
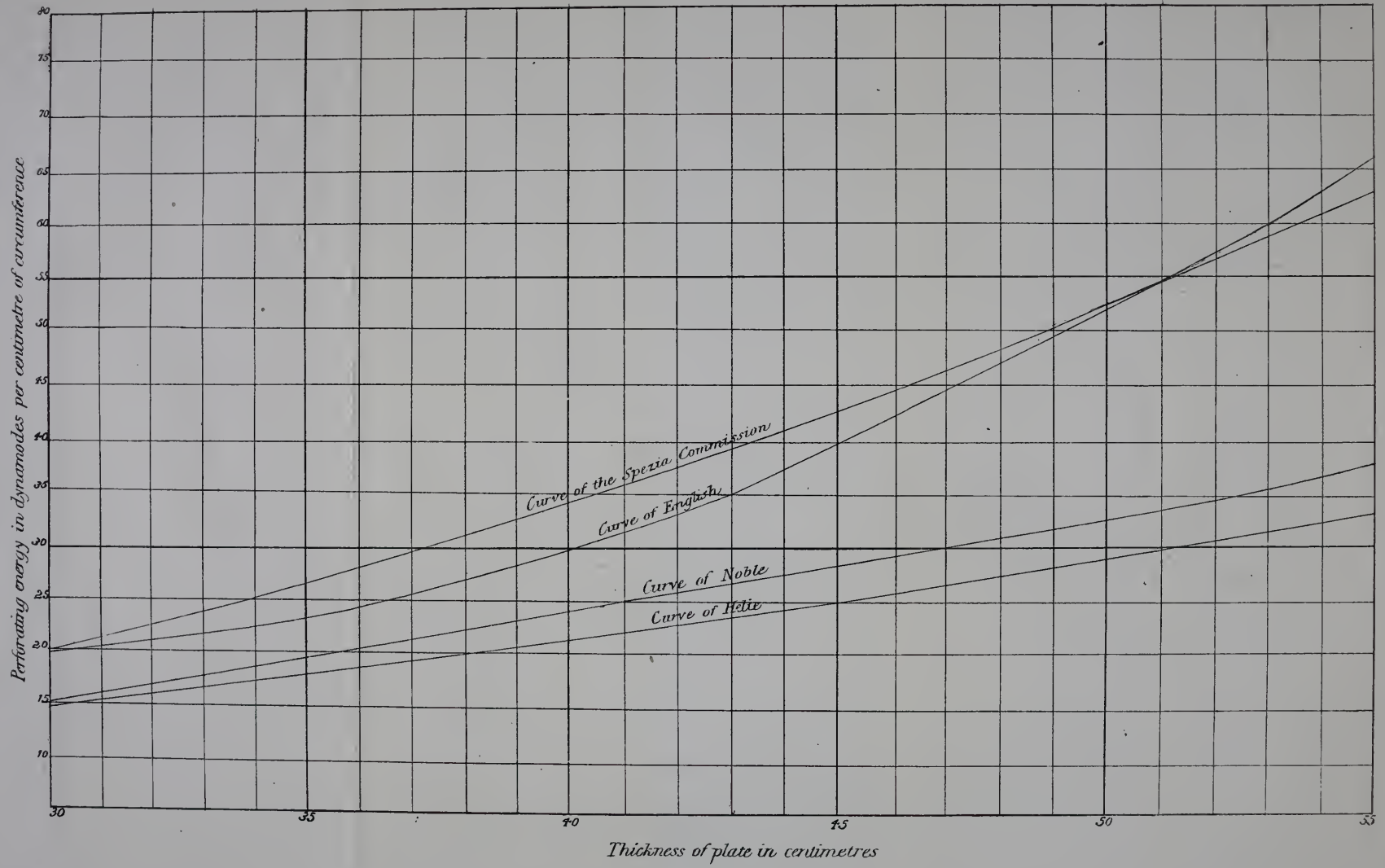


Fig 5.
(RIGHT TARGET)
11th round with 100 ton gun against Schneider Plate.

Fig 6.
(LEFT TARGET)
16th round with 100 ton gun against Marrel Plate of Sandwich System.

PLATE IV




Perforating energy in dynamodes per centimetre of circumference
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
Curve of the Spezia Commission
Curve of English
Curve of Noble
Curve of Helie
30
35
40
45
50
55
Thickness of plate in centimetres

PAPER II.

ON THE ELECTRICAL

RESISTANCE OF CONDUCTORS

AT HIGH TEMPERATURES.

By Capt. J. T. Bucknill, R.E.

In a paper *On the Dependence of Electrical Resistance on Temperature*, communicated on the 17th December, 1874, to the Society of Telegraph Engineers, Dr. C. W. Siemens says :—

"Now, if we apply the mechanical laws of work and velocity to the vibratory motions of a body which represent its free heat, we should define this heat as directly proportional to the square of the velocity with which the atoms, or may be the molecules, vibrate.

"We may further assume that the resistance which a metallic body offers to the passage of an electrical impulse from atom to atom, or from molecule to molecule, is directly proportional to the velocity of the vibrations which represent its heat. In combining these two assumptions it follows that the resistance of a metallic body increases in the direct ratio of the square root of the free heat communicated to it. Algebraically, if R represent the resistance of a metallic conductor at the temperature T (reckoning from the absolute zero), and α an experimental co-efficient of increase peculiar to the particular metal under consideration, we have $R = \alpha \sqrt{T}$.

"This purely parabolic expression would make no allowance for the probable increase of resistance, due to the increasing distance between the adjoining particles, with increase of heat, which" (increase) "would depend upon the co-efficient of expansion, and may be expressed by β T, which should be added to the former expression.

"To these factors a third would have to be added, expressing an ultimate constant resistance of the material itself at the absolute zero, and which I call γ. Hence the formula

$$R = \alpha \sqrt{T} + \beta T + \gamma"$$

Dr. Siemens carried out a series of experiments, and found the values of α, β, γ, for various metals, among others for platinum. Diagram 1, shows the results of these experiments with a constant resistance of one unit for each metal at the zero centigrade, the abscissæ representing the temperatures measured from the absolute zero of temperature, and the ordinates representing the electrical resistances of the different wires at the various temperatures.

The iridio-platinum wire used for submarine mining purposes contains about 10 per cent. of iridium, its diameter is ·003 inch, and, at an ordinary temperature (say 20 Centigrade), its electrical resistance is about 47 ohms per yard. It is a matter of some importance that the resistance of this wire, when at or near fusing point, should be determined as accurately as possible, as it enters into several of the service tests used in submarine mining.

Experiments in the Chemical Department, at Woolwich Arsenal, have shewn that the electrical resistance, at ordinary temperatures, of the iridio-platinum wire containing 7 per cent. of iridium, was about 84 per cent. of the resistance of similar wire containing 10 per cent. of iridium (see Professor Abel's Paper on *Electric Fuzes*, read before the Society of Telegraph Engineers in 1874).

In the formula before given, therefore, γ differs considerably for platinum and for iridio-platinum.

It is, moreover, highly probable that the co-efficients α and β (see formula) differ for the above metal and its alloy.

Evidently, therefore, the resistance of the service standard wire, when at fusing point, cannot be derived with any exactitude from the diagram (1).

It occurred to me in September last that it might be possible to balance the resistance of a length of the wire by the Wheatstone's bridge arrangement and to make the wire white hot by using a testing current of such magnitude that one half of it would be sufficient to bring the wire to a white heat. With this end in view I arranged three of the 100-ohms coils, used for testing the firing battery in submarine mining, to form three sides of the balance, the fourth side being occupied by one foot of the standard wire stretched between the clips provided for test table fittings. The coils used are specially made so that strong currents of electricity do not produce appreciable alterations in the resistances, and in carrying out the following experiments care was taken to make short contacts.

Diagram 2 shows the arrangement, A B C being the coils, G

the galvanometer, x the unknown resistance (one foot of the wire), M the voltaic battery, and K_1 and K_2 the keys.

The resistance of x at 20 degrees Centigrade was first found to be 15·7 ohms, or 47·1 per yard, two cells of M being used, and 30 ohms being opened in B and in C; key K_2 was pressed for a record and instantaneous contacts were made with key K_1. M was then increased to 100 cells, and after a few trials it was found that, with 40 ohms opened in A, in B, and in C, the wire at x was made white hot when key K_2 was pressed and key K_1 left open. A detector was then inserted at G and x balanced with A at 40 Ohms.

The detector was then replaced by an astatic, and it was found that it swung slightly to the right when $A=39\frac{11}{20}$ ohms, and slightly to the left when $A=39\frac{12}{20}$ ohms.

Consequently $x=39{\cdot}575$ ohms, or 118·725 ohms per yard, or 0·989, say 1 ohm, per standard length of $\frac{3}{10}$ths of an inch.

A second foot of wire was then taken from the same spool and the experiment repeated with precisely the same results.

On comparing this result with the diagram (1), it appeared that the resistance obtained was considerably less than would be expected from Dr. Siemens' experiments. The question at once suggested itself as to whether a conductor heated by a current of electricity offers a less electrical resistance than when heated to the same temperature by other and external means.

The case was stated to Dr. Siemens, who looked into the matter and wrote to me as follows :—

"12, *Queen Anne's Gate,*
Westminster, S.W.,
20th December, 1878.

" Captain Bucknill, R.E.,
Dear Sir,

Mr. Von Fischer Treuenfeld has given me a copy of the results you obtained in experimenting upon the electrical resistance of platinum wire near to the point of fusion; and upon calculation these results I find do not differ so materially from some obtained in my own experiments as you are, I believe, inclined to think.

" Your results were 42 ohms per yard at 60° Fahr., and 119 near the fusing point of platinum, the temperature of which of course we are not in a position to obtain directly, but which you have assumed at 2000° C. It has been for a long time thought that

this temperature is much too high; it was calculated upon the assumption that the specific heat of platinum is constant at all temperatures, which is known not to be the case, whilst Dulong gives that temperature at 1400° C., assuming the rate of variation of specific heat with temperature, which he obtained at the lower temperatures, to continue in arithmetical proportion right up to the fusing point.

"Assuming then 1400° C. as the fusing point of platinum, and using the following formula (the coefficients of which were obtained with one of the samples of platinum experimented upon by me, and given in my paper on the *Electrical Resistance Thermometer and Pyrometer*) the resistance is $r = \cdot092183\ T^{\frac{1}{2}} + \cdot00007781\ T - \cdot50196$, in which T is given in absolute degrees of temperature. Adding on this account 274 to 1400 we obtain 1674, and substituting this quantity for T in the formula we obtain a resistance of 3·39989, whilst you obtain $\frac{119}{42} = 2\cdot833$.

"These numbers agree, I think, very approximately, when it is considered that the unit in my experiments is taken at the zero Centigrade, and in yours at 15° C.; that the final resistance taken by you was at a temperature somewhat below that of fusion, and, finally, that samples of platinum wire vary very considerably, both in their resistance and in the influence of temperature upon the same.

"I have the pleasure to enclose the calculation of the above results and remain,

Dear Sir,

Yours faithfully,

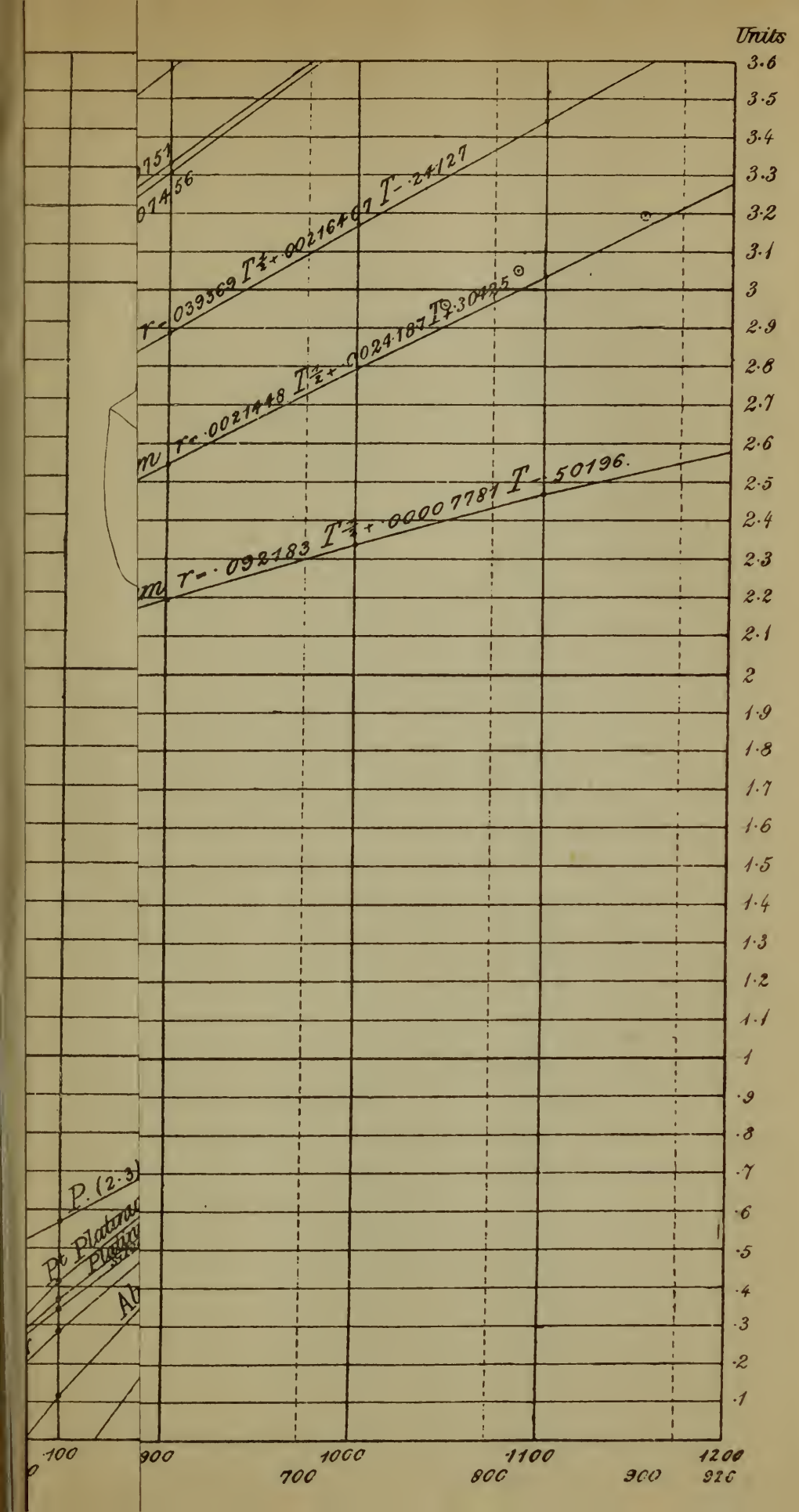
C. WILLIAM SIEMENS."

The following reply brings the matter up to the present date:—

"*War Office*, 28*th January*, 1878.

"Dr. C. W. Siemens,

Dear Sir,—Pray accept my thanks for your courteous letter of 20th ultimo, concerning the resistance of platinum wire at high temperatures, and my apologies for postponing the reply until some further experiments bearing upon the subject had been carried out. Before describing them I will first point out that the results alluded to in the second paragraph of your letter gave 47 and not 42 ohms per yard, and 118·725 instead of 119; the fraction $\frac{119}{42} = 2\cdot833$ near the end of your letter should therefore stand $\frac{118\cdot725}{47} = 2\cdot526$, and this contrasts more unfavourably with the 3·39989 obtained from your formula. Moreover, the resistance of iridio-platinum wire is, *cæteris paribus*, greater than that of platinum wire. With regard


Units
3·6
3·5
3·4
3·3
3·2
3·1
3
2·9
2·8
2·7
2·6
2·5
2·4
2·3
2·2
2·1
2
1·9
1·8
1·7
1·6
1·5
1·4
1·3
1·2
1·1
1
·9
·8
·7
·6
·5
·4
·3
·2
·1
751
074456
r=·039369 T^½ + ·0021640 T - ·24127
m r=·0021448 T^½ + ·0024187 T + ·30425
m r=·092183 T^½ + ·0000 7781 T - ·50196.
P. (2·3)
Pt Platina
Platin
Al
100
900
1000
1100
1200
700
800
900
926

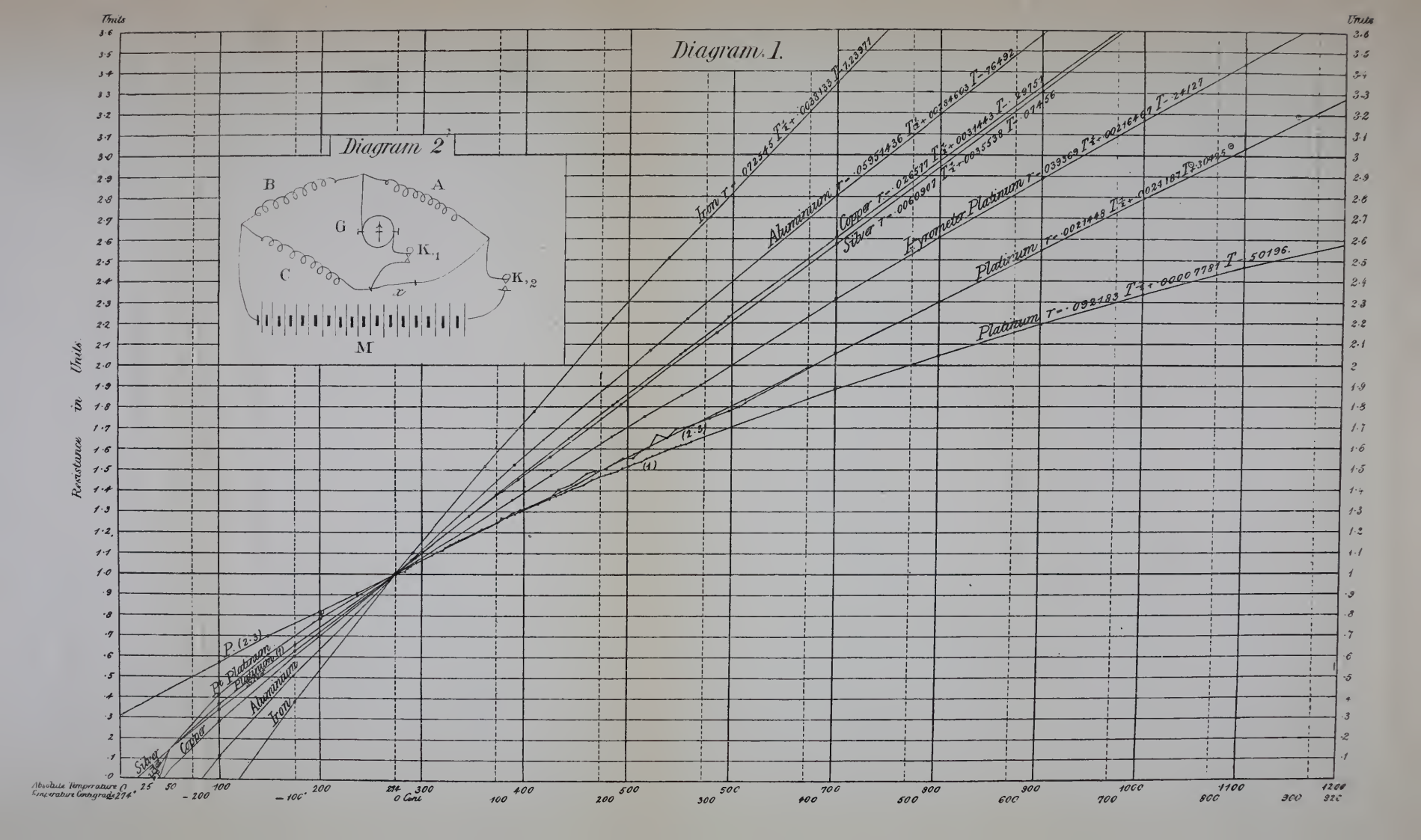


Diagram 1.
Diagram 2
B
A
G
K,1
C
K,2
x
M
Iron T = 072545 T² + 0039133 T - 123971
Aluminium T = 0595 1436 T² + 0038463 T - 76492
Copper T = 026577 T² + 0031443 T - 29751
Silver T = 0060907 T² + 0035538 T - 07456
Platinoid Platinum T = 039569 T² + 0021647 T - 24127
Platinum T = 0021448 T² + 0021187 T - 30445
Platinum T = 092183 T² + 0000 7787 T - 50196.
(2·5)
(1)
P (2·5)
Pt Platinum
Platinum (1)
Aluminium
Iron
Copper
Silver
Resistance in Units
Units
Absolute Temperature (t)
Temperature Centigrade + 274°
0 Centi

to the fusing point of platinum, you are doubtless aware that Becquerel estimated it at 1600° C., that Wedgewood and Daniell estimated the fusing point of cast iron (which is lower than that of platinum), the former at a little under, and the latter at a little over 1500° C.; also that Pouillet takes white heat to be 1300° C., and brilliant white heat to be 1500° C.

"After the receipt of your letter therefore it appeared desirable to eliminate the question as to the fusing points of the wires under trial, and simply to compare the resistance of a given wire when heated to intense white by a gas oven, with the resistance obtained when the wire is heated by the voltaic current to same degree of intense whiteness.

"This has been done, and the results on Table marked A, herewith, appear to substantiate the idea which previous experiments suggested to me, viz., that a conductor heated by a current of electricity offers a smaller resistance than when heated by other and external means to the same temperature.

"If further and more elaborate experiments prove this to be true, it appears probable that the action may be analogous to that which obtains in an insulating medium when an increase in the electromotive force applied produces a decrease in the resistance of the di-electric.

Believe me, dear Sir,
Yours faithfully,
J. TOWNSEND BUCKNILL."

Table A, showing the Electrical Resistance of one foot of Iridio-platinum Wire (about 10 per cent. iridium) 0.003 inch diameter.

	Cold.	Brilliant white heat. say 1500° C.		Remarks.
	Say 15° C.	By Gas Furnace.	By Electric Current.	
Piece 1	15·46	39·84	34·20	Wire in each case just below the point of fusion, a small increase in the gas or electric current producing fusion.
„ 2	15·78	40·18	34·50	

J. T. B.

PAPER III.

MILITARY USE OF

RAILWAYS IN INDIA.

PRECIS OF REPORT OF THE RAILWAY TRANSPORT COMMITTEE, INDIA, 1876.

Communicated by the Secretary, R.E. Committee.

A COMMITTEE was appointed by the Commander-in-Chief in India, in the beginning of 1876, to report on certain matters connected with the military use of railways in India.

This Committee was presided over by Lieut.-General Sir Charles Reid, K.C.B., and was composed of Departmental and Regimental Officers, together with a considerable number of Engineer Officers who were also Consulting Engineers to various lines of railways, and the Civilian Managers and Locomotive Superintendents of most of the railway lines of Northern India.

This Committee was divided off by the President into various Sub-Committees, and each of these Sub-Committees prepared a report on the particular subject submitted for its consideration.

No general report was prepared by the Committee as a whole, but the President himself wrote a report in his own name, and dealt with the subject from his own point of view; but did not write as representing the views of the Committee as a whole.

Extracts from the President's report, from the reports of the several Sub-Committees, and some useful tables, which give much information as to the carrying power of the Indian railways, are reprinted in this paper.

It will be noted that the principal points considered were :—

1. Is it better to load railway trucks from the sides, as customary with ordinary traffic, or is it better to adopt the system of loading from the end, this latter system making a considerable change in the construction of the trucks and wagons ?

2. To what extent can the narrow gauge railways (metre gauge), be made use of for military purposes ?

3. What are the resources of the various lines in India in respect to rolling stock ?

4. What is the best mode of carrying men, horses, guns, Engineer trains, and of fitting up wagons for the reception of sick men ?

Several highly interesting and valuable experiments were made complete trains being formed, loaded on the side and end loading systems with troops, horses, and material of various arms, and then taken along the line, halted at any given spot, the troops disembarked, and set into marching order. In each case the time taken by the whole operation was carefully noted.

It would be very difficult in England to carry out experiments of this sort, and with this degree of completeness, therefore, though the conditions are in some respects different, yet the results of these experiments are of considerable value, even with reference to moving troops and war material on European lines.

As regards movements and rapid concentration of troops in India, they are of the highest value, as giving reliable data on which to base calculation.

The proposal to convert a portion of the rolling stock on the Indian lines, so as to be specially adapted for military requirements, without withdrawing this rolling stock from use for the ordinary traffic of the railway, is only feasible in lines over which the government exercise a considerable amount of control. It is, of course, wholly out of the question in England, where the rolling stock is, and must be, formed exclusively with a view to the requirements of civil life.

The President's Report.

EXTRACTS FROM REPORT OF LIEUT.-GENERAL SIR CHARLES REID, K.C.B., TO THE QUARTER-MASTER GENERAL OF THE ARMY,

Dated 6th March, 1876.

Sir,

With reference to your letter No. 705 C, "Transport, Railway," dated Delhi, 18th December, 1875, informing me that the Right Honourable the Commander-in-Chief had been pleased, with the approval of Government, to appoint me President of a Special Committee to report on certain matters regarding the Military use of Railways in India, I have now the honour to forward, for submission to His Excellency, the accompanying report, which I regret I have been unable to report sooner ; but, owing to its bulk, it took time to compile, and pass through the Press.

A copy of the memorandum which accompanied your letter above quoted, giving the particular points to which it was suggested the attention of the Committee should be directed, having been forwarded to each Member, I deemed it advisable, before commencing work, to detail Officers of the different Arms and Departments, and form them into Sub-Committees, with instructions to carry out certain experiments both on the Broad and Narrow Gauge Railways, with the vehicles of each class of stock which were obligingly placed at our disposal by Mr. Bocquet, Railway Agent of the Sindh, Punjab and Delhi Line, and the Manager Rajpootana State Railway.

The *précis* attached to the report, which has been ably drawn up by my Secretary, Major A. LeMessurier, R.E., aided by Mr. Charles F. Call, R.E., will readily show the main points which His Excellency, the Commander-in-Chief and the Government of India would wish to arrive at.

The time of embarkation of each unit.

The actual time required for the embarkation under ordinary circumstances of an unit of each of the three arms from the side station platforms, as also from my end loading system, is shown in the report, but a good idea of the latter may be formed from the following, which was the first experiment I had at Delhi, and which would have been done in far less time with a little practice.

Embarkation of British Cavalry, 10th Hussars.

A squadron of the 10th Hussars, or 123 horses, including Officers' chargers, 68 grass-cutters' ponies, with baggage, camp equipage, ammunition, doolies, &c., fully equipped for field service, were embarked in high-sided wagons, and the train ready to start in 39 minutes.

The unloading and fixing of horse ramps took $2\frac{1}{2}$ minutes, and dismantling and reloading ramps $1\frac{1}{2}$ minutes. (*See Plate* II.)

The horses stood in the wagons head to head with poles between them, leaving room for six men to *stand*, but they were very much crowded, and in a long journey the men would have suffered much fatigue from such close packing; it was simply tried as an experiment, the supposition being that 2nd class carriages were not in sufficient number available.

Loading baggage from the side whilst end loading was going on with horses and ponies.

The baggage was brought alongside covered goods wagons on 80 camels, the weight being 674 maunds. By heaping up the baggage from the line of rail to the side doors of the wagons, a ramp was thus formed, and the whole, including camp equipage, &c., was loaded in 27 minutes, with the aid of a working party of 25 Infantry.

Two engines with tenders having been coupled on to the train, I gave the order to move across the Jumna. After passing "Shahdara," the train pulled up. The wagons were disconnected, ramps fixed at either end, and the horses and men were out, and ranged along the railway bank in 28 minutes from the time the train stopped.

The ponies and bullocks were not disembarked.

Re-embarking was accomplished in 32 minutes, including fixing, unfixing and re-loading ramps. The train then moved back to Delhi; the disembarkation of the horses occupied 27 minutes from the time the halt sounded. The ponies and bullocks were out, and the baggage loaded on the camels' backs in 25 minutes.

The disembarkation of horses, ponies, bullocks and baggage was simultaneous, four ramps being used for the animals, or two at either end of each set of wagons. The time which would be occupied in loading a whole regiment of Cavalry would depend entirely on the number of vehicles and ramps available at the place of embarkation.

A Battery of Horse Artillery fully equipped for active service with first and second line of wagons, supposing four horse ramps and two sets of girders were available, would embark in one hour, in my opinion, judging from recent experiments.

The most interesting experiment of all was with the 40-pounder Armstrong Battery, which came off at Delhi on the 29th January, 1876.

Experiments with heavy guns.

The whole Battery, consisting of three 40-pounder Armstrong guns, two 8-inch, and two $5\frac{1}{2}$-inch mortars, with 7 wagons, 2 store carts, 134 bullocks, including camp equipage, baggage, &c., fully equipped for active service, were embarked, and ready to move in 40 minutes.

* * * * * *

The train reached Ghazeeabad safely without a single mishap, and proving satisfactorily that the floors, springs and bolts of the Sindh, Punjab and Delhi Railway trucks were fully equal to this severe test.

The guns and bullocks were disembarked, the first gun being brought into action by the side of the line in 8 minutes, the second in 13 minutes and the third in 24.

These three guns were re-loaded in $12\frac{1}{2}$ minutes, showing thereby what could be done with a little practice.

* * * * * *

There is a great difference of opinion amongst Cavalry and Artillery Officers as to the best means of packing horses.

There is no doubt that the high-sided wagons on the broad gauge will hold eight Waler or stud-bred horses placed transversely, but this method leaves no room for the men who remain with the horses, and they are liable to be trampled upon.

The British Cavalry Officers whom I consulted were rather in favour of six horses in a wagon with heads to the centre, and two poles, to keep the horses from pressing in on the men,—in fact just as the altered wagons are at present fitted on the Sindh, Punjab and Delhi Railway, and as suggested in my report of the 20th April last.

The Officers of the Native Cavalry again, as a rule, rather preferred the transverse method; this difference of opinion is easily accounted for. The European requires more room and air space than a native, who can always make himself small, and can squat anywhere, whereas a European cannot. I am inclined to think, however, from the experience gained by several experiments, that eight horses placed transversely is the best method, as they are more readily removed, and there is less strain on the horses when the train is in motion; but they should have nothing on their backs but their clothing. (*See Plate* V.)

Cavalry saddles and Artillery harness are easily packed and placed in a spare wagon close to the horses. The saddles would not get wet, as the wagons are provided with roofs, which I consider are essential, inasmuch as they afford shelter for men and horses, and will prevent any risk of horses jumping out of the high-sided wagons, which they might do if they got frightened on seeing a train pass at full speed.

In placing eight horses in a wagon transversely, it will be necessary to have rings fixed along the side of the wagon, about 6 inches from the top, so as to secure the horses' heads when not feeding, and I see no necessity for any troopers or drivers remaining with the horses; three syces in each wagon will, I think, suffice, always supposing that there is sufficient room for the men in the second class carriages; if not, they must manage to find room with their horses; but the advantage gained of carrying *eight* horses in a wagon instead of six is very great indeed, particularly if Cavalry or Artillery were required on an emergency, and there was a deficency of high-sided wagons for their conveyance.

By removing saddles and harness from the horses' backs they will not only have more room, and feel more at ease, but it will be found

there is less difficulty in getting them out, as on several occasions I have seen the harness catch whilst turning a horse round in a wagon; I therefore suggest the removal of saddles *only* from Cavalry horses, *not* bridles, and the harness *only* from Artillery, which can be placed on the trucks by the side of the guns, provided there is no rain, in which case it should be placed under cover. When horses are feeding, the bridles can be removed, but in taking a horse out he should decidedly be bitted.

* * * * * *

Although it may not be deemed expedient to alter the whole of the rolling-stock, so as to admit of the end loading system, which I so strongly advocate, I would beg to suggest, for the consideration of Lord Napier of Magdala and the Government of India, whether it would not be desirable to have a certain number of vehicles altered on all the different lines in India, say from 150 to 200 high-sided wagons and 100 low-sided trucks. These might be kept always ready in case of an emergency at Bombay, Madras, Calcutta, Allahabad, Delhi, and Lahore. This would be a beginning, I venture to think, in the right direction; but I cannot too strongly urge on the Government the necessity of having the whole of the rolling-stock, which may from the present time be constructed on the different lines, whether broad gauge or narrow, of one uniform pattern with end openings; the dimensions of each vehicle, as regards height, length, breadth, thickness of floors, distance between buffers, &c., being clearly laid down and strictly adhered to.

* * * * * *

Metre gauge.

I was most anxious to test the metre gauge, but much regret I was not provided with the means of doing so.

The vehicles produced at Delhi were, I consider, totally unsuited for any experiment, and I was afraid to move the train with horses' heads and necks over the side of the wagons.

The ends of the vehicles had been knocked out so as to admit of end loading, which is undoubtedly the best suited for the narrow gauge; but in doing this the carriages were weakened, and the flooring looked anything but strong, so much so that Lieutenant-Colonel Corden, R. A., agreed with me in thinking that it would be dangerous to attempt moving the train. A reference to the remarks made by Lieut.-Colonel Corden, R.A., who was a member of the Committee, will show that he bears me out in the opinion I have expressed.

Finding that the metre gauge could not be satisfactorily tested at

Delhi with the vehicles produced, I suggested that some experiments should come off here; but I am again disappointed, as I find the Punjab Northern State Railway has a minimum supply of rolling-stock—in fact there are but five open high-sided wagons upon it and Colonel Williams, the Director, informs me that it would be inconvenient to withdraw or divert any of its stock.

Colonel Williams suggests the desirability of carrying out experiments at either Agra or Delhi on the Rajpootana Line; but now that the Members of my Committee are all scattered, this will be impossible. It would therefore seem desirable that the metre gauge experiments should be deferred until suitable stock is available with the required alterations in the vehicles for end loading, which Colonel Williams is apparently anxious to carry out.

* * * * * *

(Signed) CHARLES REID,

LIEUT.-GEN., &c., &c., &c.

The end loading system alluded to in this report is as follows:—

Description of End Loading System.

Several wagons or trucks are placed together, by preference on a siding, and the ends of these wagons are made to flap down, so as to cover the space over the buffers, and thus to convert the wagons into a continuous platform.

Timber or iron ramps, specially made for the purpose, are placed leading up to the end of one or of both of the end wagons, and the series of trucks are loaded up these ramps.

These ramps or guiders were designed by Sir Charles Reid. The following description, together with the sketch or plate will make their construction clear. (*See Plates* I. *and* II.)

RAMPS AND GIRDERS.

Broad Gauge.—Sir. C. Reid's ramp for embarking horses consists of two side frames of Sál timber, each weighing 300 lbs., braced at the head resting on the rails, and reaching to the end flap (open) of the wagon. Loose Sál planks of different thickness, weighing altogether 1000 lbs., are laid alternately on the top of the side frames, and give a slope of 1 in $3\frac{3}{4}$ for the cattle to walk up and descend. Its weight complete is 1600 lbs., and can be handled in pieces easily by two men.

Sir. C. Reid's girder for guns consists of two solid rolled wrought H irons 5″ × 10″ × 14′ long, fitted with side handles. Plates are rivetted to one end to form a rest upon the end flap of the wagon, and to prevent the girder from canting over. The gun wheels follow in the track of the girders.

The weight of a single girder is 550 lbs., and can be moved with ease by six men; the pair are strong enough for loading 81-cwt. guns, and can be fixed in a few minutes.* (*See Plates* I., II., & IV.)

PRECIS OF EXPERIMENTS.

END LOADING—Broad Gauge.

Cavalry.

On 3rd January, 1876.

One Squadron 10th Hussars, Heavy Marching Order.

Open Siding, S. Punjab and Delhi Railway.

Working Party, 100 *Infantry.*

2-12	P.M.	Began loading (bugle).
2-39	,,	674 maunds baggage loaded (27 minutes).
2-43	,,	64 ponies and cattle loaded (31 minutes).
2-51	,,	123 horses and Hussars loaded (39 minutes).
3-0	,,	Train started.
3-15	,,	Train stopped 4th mile.
3-25	,,	Horses began to disembark.
3-43	,,	Horses out and ranged along bank (28 minutes).
3-45	,,	Orders to re-embark.
4-4	,,	All horses in (19 minutes).
4-9	,,	Ramps in and doolies loaded (5 minutes).
4-16	,,	Train moved off.
4-40	,,	Returned to station siding.
4-52	,,	Horses began to disembark.
5-7	,,	All horses out ,, ponies and cattle ,, baggage, and on camel back. — 27 minutes after halt.

END LOADING—Broad Gauge.

Heavy Artillery.

On 28th January, 1876.

1/21 *Royal Artillery.*

Open Siding, S. P. D. R. Yard.

60 *Gunners, and Working Party* (50 *Men*), 1/6*th Regiment.*

11-30	A.M.	Began loading (bugle).
11-55	,,	134 bullocks and 67 men (25 minutes); also camp equipage, baggage, and elephant gear.

* The construction of similar ramps used in France can be seen in *Plate* IV.

12-30 P.M. 3 40-Pr. B. L. guns, 3 mortars, 7 ammunition wagons and 2 store carts, all in but not fixed (1 hour).
1-40 „ Train started.
2-10 „ Train stopped at Ghazeeabad.
2-17 „ Train uncoupled.
2-25 „ 1st gun fired in 8 minutes
2-30 „ 2nd gun fired in 13 minutes } From the time the train was coupled.
2-41 „ 3rd gun fired in 24 minutes
2-40 „ All bullocks out in 23 minutes.
2-50 „ Bugle to re-embark.
3-0 „ Bullocks loaded in 10 minutes.
3-3 „ All three guns loaded in 13 minutes.
3-37 „ Train started after halt.
4-5 „ Train stopped.
4-10 „ Bugle to disembark.
4-25 „ Bullocks out in 15 minutes.
4-49 „ Third gun down in 39 minutes.
4-52 „ Elephants saddled and off.
4-55 „ Baggage out and started.
5-27 „ Last ammunition wagon out.
5-30 „ Battery moved off (1 h. and 25 m. from halt).

This was no test, as the men were fatigued after a long day's work.
C. REID.

END LOADING—BROAD GAUGE.

HORSE ARTILLERY.

On 29th January, 1876.

C/A. Royal Horse Artillery.

5 *Sergeants*, 118 *Men*, 124 *Public Followers.*

Open Siding, Sindh, Punjab, and Delhi Railway Yard.

Working Party, 40 *Infantry.*

11-03 A.M. Bugle to embark.
11-40 „ Baggage and camp equipage, 267 maunds, loaded.
11-43 „ 6 9-Pr B. L. guns, 6 ammunition wagons, forge, spare gun carriage and store wagon loaded in 40 minutes.
11-57 „ 178 horses, 62 gunners, loaded in 54 minutes.
12-45 P.M. Bugle to disembark.
1-5 „ Guns and wagons all out in 20 minutes.
1-9 „ Horses out in 24 minutes.
1-22 „ Bugle to re-embark.
1-31 „ Trucks run back, ramps fixed, 1st horse going in.
1-47 „ Guns, &c., all loaded in 25 minutes.

2-4 P.M. Horses all loaded in 42 minutes.
2-6 „ Ramps in and trucks coupled on.
2-15 „ Bugle to disembark.
3-17 „ Battery ready to move off in 62 minutes.

END LOADING—Broad Gauge.

Cavalry.

31st January, 1876.

15th Hussars, and 4th Bengal Cavalry.

Open Siding, Sindh, Punjab and Delhi Railway.

1st Troop, 15th Hussars—72 horses were unsaddled, loaded 8 horses to a truck at right angles to the line of rails, and saddles packed in 43 minutes.

2nd troop through improper coupling of trucks took a longer time.

In unloading, the 1st troop took 11 minutes, and the 2nd troop 16 minutes, to disembark and form up.

SIDE LOADING—Broad Gauge.

Artillery.

On 23rd and 24th January, 1876.

F/19 R. A., Captain Wright, leaving Delhi for Agra.

Side Platform, East Indian Railway.

12 noon to 1-7 P.M. — 6 9-Pr. Armstrong guns, 6 ammunition wagons, 2 store wagons, 1 spare carriage, 1 forge wagon, and 2 battery carts, were loaded into 14 low-sided trucks in 45 minutes. The guns were lashed to the trucks and covered with tarpaulins in 67 minutes.

The baggage and train was completed in $1\frac{1}{2}$ hours.

The 2nd train, containing 115 horses, 40 syces, 46 ponies, 24 grass cutters, 26 bullocks and 13 bullock drivers, with 337 maunds of hospital and camp equipage, was loaded in 2 hours.

Side Platform, East Indian Railway.

Cavalry. The 10th Hussars moved to Agra by 2 special trains of 73 vehicles in all, on the 18th and 20th January, and 2 detachments went by the ordinary mixed trains on the 17th and 19th.

Infantry. The 8th Regiment Native Infantry moved to Agra on the 21st January in a train of 35 vehicles.

The 85th Regiment K. L. I. was despatched to Lucknow in two trains of 57 vehicles in all on the 24th and 25th January.

The 45th Regiment Native Infantry, proceeded on relief to Calcutta on the 28th January in a train of 34 vehicles.

PONTOON AND TELEGRAPH TRAIN.

On 27th January, 1876.

Goods Platform Siding, S. P. and D. R.

A train containing a half unit of pontoon equipment, with its service complement of men, baggage and camp equipage can be loaded and dispatched within an hour.

A half unit of telegraph wagon train can be dispatched in 45 minutes.

SIDE LOADING—Broad Gauge.

Infantry,

On 1st February, 1876.

1/6 *Foot.*

Open Siding, Sindh, Punjab and Delhi Railway.

16 Officers, 604 men of all ranks, with followers, baggage and camp equipage, were loaded in half an hour.

The Battalion disembarked and marched out of the yard, camels loaded, in three-quarters of an hour.

END AND SIDE LOADING—Metre Gauge.

On 31st January, 1876.

Field Artillery, Infantry, Pontoon and Telegraph Trains.

Platform Siding, Rajpootana State Railway.

End Loading.—Three horses were loaded into a converted cattle truck in two and a half minutes.

One gun and limber and one ammunition wagon and limber were loaded in eight minutes on to two trucks.

Side Loading.—A forge wagon without its limber was loaded in half a minute in a high-sided truck.

Pontoon Train.—Two chess carts were dismantled and loaded into a high-sided truck, and then unloaded, placed on their wheels and re-packed in about ten minutes.

Telegraph Mule Train.—Six miles of wire were packed into a covered van in four minutes, and the mules, saddles, and equipment, complete, in 16 minutes.

In Table C the times of loading and unloading trains on both gauges, and on both systems, are given in tabular form.

PRECIS OF SUB-COMMITTEE REPORTS.

COMMISSARIAT.

Col. A. D. Dickens, C.B.
Surg-Maj. J. Kellie, M.D.
„ F. F. Allen, C.B.

Covered wagons of all sizes and capacities are suitable for stores. End openings are preferred if large numbers of cattle have to be embarked, but side openings have the advantage for stores in offering more openings to work at.

Forage,* malt liquor, and stores of a perishable nature, might be conveyed in open trucks.

No alteration to rolling-stock is needed to meet Commissariat wants.

Broad Gauge.—An ordinary 6-ton goods wagon can be easily loaded from the side in half an hour.

The ordinary goods wagon with side ventilators, used during the Abyssinian war for transport of mules, seems all that is required for cattle and sheep. Twelve head of cattle were loaded into this wagon in five minutes, and 50 sheep in three minutes. The unloading occupied less time, the animals entering and descending from a ramp of six sleepers lashed together.

Metre Gauge.—A cattle wagon was loaded from the side with eight head of cattle or 30 sheep in 10 minutes.

Supplies for Seven Days for each Unit of the Service and the Vehicles required are—(vide Table A.)

	Cattle.	Sheep.	Rations.	Total Vehicles.	
				Broad gauge.	Metre gauge.
	No.	No.	Mds.		
Regiment, British Infantry	40	44	521	7	11
„ „ Cavalry	21	23	736	8	10
Battery, Horse Artillery	7	7	278	4	4
Battery, Field „	7	7	244	4	4
Battery, Heavy Field Artillery	5	4	868	8	10
„ Mountain „	5	4	414	4	4
Regiment, Native Infantry	...	...	152	1	2
„ „ Cavalry	...	...	521	3	4
Company of Sappers and Miners	...	1	26	½	½

One wagon for each regiment and battery should be added for carriage of regimental bazár and supplies of followers.

* Covered by tarpaulins.

MEDICAL.

* * * * * *

The Sindh, Punjab and Delhi Railway pattern hospital carriages (*see Plate* III.) would satisfy all wants; they hold 8 beds, 4 on each side, and, by shifting the berths nearer to one end, a space would be gained for widening the doors.

Five carriages with end communications would suffice for a hospital train, viz. :—

3 carriages for 24 seriously wounded;
1 carriage „ dispensary, instruments, &c.;
1 „ „ officers and subordinates.

A great economy in doolies and bearers could be effected if each carriage is provided with stretchers.

Men wounded in action would be removed in common doolies to a hospital train close at hand, and then transferred on stretchers to their berths in the train; the doolies could at once return to the front. The train after a run of not more than 6 hours from the scene of action would reach a general depôt hospital on or near the line, and the men would be again transferred on these carriage stretchers to doolies which had been sent to meet them. Thirty doolies with bearers should form part of this hospital establishment.

* * * * * *

Special ambulance carriages would neither serve for passengers or goods traffic, or for ordinary military requirements.

Ordinary first and second class passenger carriages are suitable for the transport of such soldiers as are able to rise from their beds or to walk with assistance; but special arrangements are necessary when doolies containing the seriously wounded men have actually to be placed in the carriage.

* * * * * *

Existing vehicles should be adapted for the conveyance of sick and wounded, rather than special carriages constructed.

Colonel Pollard,
Major de Bourbel,
„ Stanton,
„ Smith.

When badly wounded men have to travel by rail, they should not be moved from the doolies in which they were brought from the field.

Long third class and intermediate carriages can be most easily altered, with doors not less than 3′ 9″ wide at both ends, and with seats and partitions removable, thus admitting 12 to 16 doolies in two tiers.

All first and second class carriages should have end doors for the passage of Medical Officers.

Postal vans are available for dispensaries.

The suggested pattern of covered goods wagon would be available.

Doolies can be suspended in slings, or on transverse straps, as suggested by Sir C. Reid.

Ten per cent. of the existing third and intermediate classes would give 150 ambulance wagons at a very short notice, capable of accommodating 1800 patients, and it is recommended that this proportion be prepared at once.

SIEGE ORDNANCE.

Metre Gauge.—The vehicles are not at all suitable for conveyance of siege guns, &c.

Broad gauge.—Each of the vehicles—

* * * * * *

Bombay Committee Report.

140 rail and timber } On the Great Indian
923 low-sided open } Peninsula Railway,

and—

516 flat cotton } On the Bombay, Baroda
56 timber } and Central India
372 low sided } Railway.

can carry—

One 18-pounder gun on carriage with limber,			or
One 24-pounder gun	ditto	ditto,	or
One 40-pounder gun	ditto	ditto,	or
One 10-inch howitzer	ditto	ditto,	or
One 8-inch howitzer	ditto	ditto,	or
Two $5\frac{1}{2}$-inch mortars	ditto	ditto.	

A certain proportion of the vehicles on both lines should have the sides to let down flapwise, and of the high open wagons the doors should be widened to not less than eight feet.

ARTILLERY.

A Battery of Heavy Artillery, could be conveyed in 102 broad gauge trucks: embarkation from side platforms would take $4\frac{1}{2}$ hours, and disembarkation 2 hours.

Major Hunter, R.A.

By the end loading system these times would be reduced to 3 and $4\frac{1}{2}$ hours.

The baggage should be in front, then men, guns, ordnance carriages, and the powder in the rear.

A Battery of Horse Artillery conveyed in three trains should be properly distributed, each train containing a division complete; vehicle space should be utilised as much as possible to carry three sets of wheels. Guns and wagon bodies to have trails and perches inwards; limbers to have shafts inwards resting on carriages shafts inwards.

Harness should only be left on the horses for night journeys under twelve hours in the cold season.

On longer journeys the harness should be packed in covered wagons.

A Battery of Horse Artillery without its second line of wagons, Hospital, or any Commissariat, would require 84 broad gauge trucks.

The loading and unloading from side platforms would be the same as by the end loading, $2\frac{1}{2}$ hours: by the end loading system, embarkation would take 2 hours, and disembarkation $1\frac{1}{2}$ hours.

The horses should be in front, to be followed by the men, guns and baggage, with the cattle in the rear.

Metre Gauge.—The number of vehicles would be 134.

* * * * * *

CAVALRY.

* * * * * *

Packing horses side by side with their heads towards the side of the wagon saves time, and there is less strain on the horses when the train moves or stops; but greater protection to the men, and greater facility for feeding is secured by placing the horses fore and aft with their heads to the centre.

Horses should be unsaddled when conveyed by rail, as it takes five trucks less per squadron than if they were saddled; the horses are saved the weight of the saddles, and have less freedom to kick, and the saddlery is saved. Placing horses fore and aft is preferable to placing them in line. (*See Plate* V.)

* * * * * *

The stallions of the Native Cavalry should be put into wagons with geldings as much as possible; horses should travel unsaddled; one wagon will hold the saddles of a squadron of Cavalry, 144 strong.

* * * * * *

On the Madras Railway over 1000 horses are annually carried in trucks loaded transversely.

INFANTRY.

A full battalion would take 97 vehicles, and one hour should be allowed for loading and the same for unloading from the side.

Lieut-Col. Montgomery, Major H. Collett, Captain Crookshank.

End loading does not apply to Infantry.

Wagons containing camp equipage or ammunition should be placed away from the engine.

A covered goods van will hold 16 men with their tent E.P., camp equipage and baggage complete, or 20 men with kits and 2 bell-tents.

Metre Gauge.—The first class will carry 9 Officers; the second 24 soldiers, or 32 followers; and the ordinary complement of those with longitudinal seats should be 20 soldiers, or 27 followers.

PONTOON TRAIN.

The field equipment of a pontoon train has not yet been authoritatively laid down: trucks carrying pontoons or trestles should be placed between those carrying the chess or store carts. Three chess carts, by tilting and removing the poles, can be packed in one truck occupying a length over all of 24 feet. An end ramp was made from one bay of the pontoon superstructure, and the loading occupied less time than by the side.

Major Smith, R.E. „ Collett

The bridge equipment of a pontoon-train for 50 yards of bridge with ammunition, &c., complete, could be loaded and despatched in one hour. There would be no difficulty in unloading at any point along the line. (*vide* Tables D. & F.)

TELEGRAPH WAGON TRAIN.

A train sufficient to carry 18 miles of wire with its service complement of ammunition, equipment, tents and baggage could be loaded and despatched in three-quarters of an hour.

Metre Gauge.—The equipment of the mule train sufficient for 6 miles of wire occupied when packed one third of an ordinary goods wagon.

A truck will carry either a pontoon wagon or a wire wagon, or an office wagon, or two chess carts dismantled.

Trucks carrying pontoons must be separated from one another and from a covered wagon by a truck containing stores.

The times of loading and despatch would not be greater than on the broad gauge—(*vide* Tables E. G. H.)

DRILL.

Soldiers and horses at Military Stations should be practised in Railway drill; and Railway servants, in their turn, should be taught to recognise Military stores and fit up ambulances.

Mr. H. P. LeMesurier, *Agent G. I. P. R.*

Tracings of defensive works for stations and bridge heads should be furnished to the Railway Engineers.

At all large stations on the line of rail, men should be regularly practised at both side and end loading.

Colonel Pollard,
Major de Bourbel,
" Stanton,
" Smith.

RAILWAY PIONEERS.

Ordinary knowledge of Railway construction might be secured by employing Infantry on working pay to lay out a Military line from Roorkee to Saharunpore.

Major Warren, R.H.A.

CAPACITY OF INDIAN RAILWAYS.

Tables of broad gauge rolling-stock available in India are submitted with a view to ascertain in what manner and in what space of time a force similar to that lately assembled at Delhi, viz. :—

Colonel Pollard, R.E.
Major de Bourbel, R.E.,
" Stanton, R.E.,
" Smith, R.E.

13 Regiments Cavalry,
13 Batteries Artillery,
25 Regiments Infantry,
2 Companies Sappers,
} with 7 days' supplies,

could be collected from all parts and concentrated at Lahore, and to test the carrying capacity of the different lines from a military point of view.—(Tables B. and J).

The recommendations of the Sub-Committee may be thus summarized—

Summary.

1. That, at cavalry and artillery stations on the lines of railway, men should be regularly drilled in embarking and disembarking their horses and guns, both with side and end loadings where there are no permanent platforms.
2. That at least four sets of Sir C. Reid's girders and ramps, with the additions necessary to fit them for side loading, be made up and kept at all such stations as military stores.
3. That in future covered goods' wagons should be constructed

according to the type shown in Mr. Carroll's drawing, the interior dimensions being 18 ft. × 8 ft. × 6 ft. 6 in. at doors, from floors to cant rail, with a door width of 6 feet.

4. That all low-sided wagons be in future constructed with ends, and not less than 12 feet of their sides to let down.
5. That a certain number, say 10 per cent. to begin with, of intermediate or third class carriages of the type, 26 ft. to 28 ft. in length be constructed, with end door openings not less than 3 ft. 9 in. wide, and with all seats and partitions so arranged as to be easily removable to adapt the carriage to ambulance purposes.
6. That first and second class carriages be constructed with end openings for through communication.
7. That longitudinal planks or iron plates should be used as wheel-bearers in trucks carrying guns in military wagons.
8. That railway companies be invited to test practically whether covered goods' wagons can be fitted with end and side openings without unduly weakening them, increasing materially their cost, or impairing their efficiency for commercial purposes.

N.B.—*A précis of the Report on the Adaptation of Rolling Stock to Military Purposes will be given in another Paper.*

TABLE A.

RETURN OF COMMISSARIAT SUPPLIES FOR SEVEN DAYS.

Statement showing the Weight of Commissariat Supplies accompanying the several Units of a Force, with number of

Vegetables ... ... ,,	8	...	...	...
Dál ... ... ,,	2·75	15·75	10	2·50
Sugar ... ... ,,	1·25	...	...	...
Ghee ... ... ,,	1·25	7·75	4·50	1·25
Tea ... ... ,,	0·50	...	...	...
Rice ... ... ,,	2	...	...	...
Salt ... ... ,,	0·75	3·75	2·25	0·50
Fire-wood ... ... ,,	24	...	...	0·50
Gram ... ... ,,	93·50	...	423·50	...
Barley ... ... ,,	...	...	...	...
Rum ... ... Gallons	16 or 3 mds.	...	...	...
Grass ... ... Mds.	218	...	...	...
Bhúsa ... ... ,,	...	...	...	...
Dry fodder ... ... ,,	...	...	...	...
Ovens ... ... Nos.	1	...	...	...
Scales and Weights ... ... ,,	1	...	...	...
Cooking Utensils ... ... Mds.	5	...	...	...
Tents for Commissariat Establishment	25	...	...	...
Total Maunds ...	**414**	**152**	**521**	**25·39**
Total tons ...	**14·75**	**5·5**	**18·5**	**1**
No. of goods wagons { Broad Gauge ...	3	1	3	...
{ Metre ,, ...	3	2	4	...
Grand Total Wagons { Broad Gauge ...	**4**	**1**	**3**	**0·25**
{ Metre ,, ...	**4**	**2**	**4**	**0·33**

...ns for two British Non-Commissioned Officers.
...iage of the Regimental bazárs and supplies for
...rs is not included.
...on for each Regiment or Battery would suffice.
...l, dry fodder and grass would seldom require to
...ied by train.

TABLE A.

RETURN OF COMMISSARIAT SUPPLIES FOR SEVEN DAYS.

Statement showing the Weight of Commissariat Supplies accompanying the several Units of a Force, with number of Vehicles required for transport, both by Broad and Metre Gauge.

Supplies.	1 Regiment of British Infantry. *Strength.* 9 Staff Sergeants. 876 Men. 885	2 Regiment of British Cavalry. *Strength.* 12 Staff Sergeants. 444 Men. 456 503 Horses.	3 Battery of Royal Horse Artillery. *Strength.* 2 Staff Sergeants. 155 Men. 157 193 Horses.	4 Battery of Field Artillery. *Strength.* 2 Staff Sergeants. 155 Men. 157 118 Horses. 27 Bullocks.	5 Battery of Heavy Artillery. *Strength.* 2 Staff Sergeants. 87 Men. 171 Natives. 13 Horses. 290 Bullocks. 9 Elephants.
Cattle ... ... Nos.	40	21	7	7	5
Sheep ... ... ,,	44	23	7	7	4
No. of cattle wagons. Broad Gauge ...	4	3	2	2	1
No. of cattle wagons. Metre ,, ...	7	4	2	2	1
Flour ... ... Mds.	75·77	38·75	13·50	13·50	8
Atta... ... ... ,,	...	...	...	...	4·25
Vegetables ... ... ,,	75·75	38·75	13·50	13·50	8
Dál ... ... ,,	...	...	...	...	3·75
Sugar ... ... ,,	11	6	2·25	2·25	1·25
Ghee ... ... ,,	...	...	...	...	2
Tea ... ... ,,	3·25	1·75	0·75	0·75	0·50
Rice ... ... ,,	18·75	9·75	3·25	3·25	2
Salt ... ... ,,	3·25	1·75	0·75	0·75	1
Fire-wood ... ... ,,	226·75	116·50	40·25	40·25	23·50
Gram ... ... ,,	...	220	84·50	51·50	163·75
Barley ... ... ,,	...	220	84·50	51·50	...
Rum ... ... Gallons	154 or 21¼ mds.	79 or 11¼ mds.	27·48 or 4¼ mds.	27·48 or 4¼ mds.	16 or 3 mds.
Grass ... ... Mds.	...	...	...	...	32
Bhúsa ... ... ,,	...	...	...	33	355·25
Dry fodder ... ... ,,	...	...	...	...	189
Ovens ... ... Nos.	9	5	2	2	1
Scales and Weights ... ... ,,	...	1	1	1	1
Cooking Utensils ... ... Mds.	45	30	5	5	5
Tents for Commissariat Establishment	35	35	25	25	25
Total Maunds ...	**521**	**736**	**278**	**244**	**868**
Total tons ...	**18·5**	**26·25**	**9·95**	**8·5**	**31**
No. of goods wagons. Broad Gauge ...	3	5	2	2	7
No. of goods wagons. Metre ,, ...	4	3	2	2	9
Grand Total Wagons. Broad Gauge ...	**7**	**8**	**4**	**4**	**8**
Grand Total Wagons. Metre ,, ...	**11**	**10**	**4**	**4**	**10**

Supplies.	6 Battery of Mountain Artillery. *Strength.* 2 Staff Sergeants. 92 Men. 119 Natives. 178 Mules.	7 Regiment of Native Infantry. *Strength.* 16 Native Officers. 696 Men.	8 Regiment of Native Cavalry. *Strength.* 13 Native Officers. 444 Men. 484 Horses.	9 Company of Sappers and Miners. *Strength.* 2 British Non-Com. Officers. 2 Native do. 114 Men.	Remarks.
Cattle ... ... Nos.	5	...	...	...	
Sheep ... ... ,,	4	...	...	1	
No. of cattle wagons Broad Gauge ...	1	...	...	...	
No. of cattle wagons Metre ,, ...	1	...	...	...	
Flour ... ... Mds.	8	...	...	0·64*	
Atta ... ... ,,	21	124·75	80	20	
Vegetables ... ... ,,	8	...	...	...	
Dál ... ... ,,	2·75	15·75	10	2·50	
Sugar ... ... ,,	1·25	...	...	...	
Ghee ... ... ,,	1·25	7·75	4·50	1·25	
Tea ... ... ,,	0·50	...	...	...	
Rice ... ... ,,	2	...	...	...	
Salt ... ... ,,	0·75	3·75	2·25	0·50	
Fire-wood ... ... ,,	24	...	...	0·50	
Gram ... ... ,,	93·50	...	423·50	...	
Barley ... ... ,,	...	...	...	...	
Rum ... ... Gallons	16 or 3 mds.	...	...	...	
Grass ... ... Mds.	218	...	...	...	
Bhúsa ... ... ,,	...	...	...	...	
Dry fodder ... ... ,,	...	...	...	...	
Ovens ... ... Nos.	1	...	...	...	
Scales and Weights ... ... ,,	1	...	...	...	
Cooking Utensils ... ... Mds.	5	...	...	...	
Tents for Commissariat Establishment	25	...	...	...	
Total Maunds ...	**414**	**152**	**521**	**25·39**	
Total tons ...	**14·75**	**5·5**	**18·5**	**1**	
No. of goods wagons Broad Gauge ...	3	1	3	...	
No. of goods wagons Metre ,, ...	3	2	4	...	
Grand Total Wagons Broad Gauge ...	**4**	**1**	**3**	**0·25**	
Grand Total Wagons Metre ,, ...	**4**	**2**	**4**	**0·33**	

* Dry rations for two British Non-Commissioned Officers. The carriage of the Regimental bazárs and supplies for followers is not included.
One wagon for each Regiment or Battery would suffice.
Fire-wood, dry fodder and grass would seldom require to be carried by train.

TABLE B.

ROLLING STOCK.

The total stock per open mile, and the deduction necessary on account of ordinary repairs, are shown below :—

Open Miles.		*Engines.* Passenger and Goods.	1st, 2nd, 3rd, 4th, and intermediate class, Composite, Hospital, Prison, Post Office.	*Brake-vans.* Passenger and Goods.	Horse, cattle, sheep, and poultry vans.	Covered goods, luggage and powder vans.	Coke and high-sided.	Carriage platform, open-sided, low-sided trucks.	Miscellaneous.	Total.	Deduction for ordinary repairs.
											Per cent.
1504	E. I. R. ...	520	673	270	129	3,854	212	1,278	1,172	7,588	6 to 8
	Per open mile	·34	·44	·17	·08	2·56	·14	·84	·77	5·04	
1279	G. I. P. R. ...	*296	780	†404	226	3,089	406	2,968	...	7,873	15
	Per open mile	·23	·61	·31	·17	2·41	·31	2·32	...	6·15	
858	Madras ...	94	378	85	85	51	2,245	456	...	3,300	20
	Per open mile	·10	·44	·09	·09	·05	2·61	·53	...	3·84	
554	S. P. & D. R. ...	131	340	68	29	1,563	90	477	...	2,567	10 to 12
	Per open mile	·23	·61	·12	·05	2·82	·16	·86	...	4·65	
540	O. & R. R. ...	51	211	34	20	546	67	212	11	1,101	6 to 8
	Per open mile	·09	·39	·05	·03	1·01	·18	·39	·02	2·03	
408	B., B. & C. I. R.	85	196	49	87	1,087	27	1,610	...	3,056	10
	Per open mile	·20	·48	·12	·21	2·66	·06	3·94	...	7·44	
83	S. I. Railway ...	21	43	12	3	175	50	105	...	388	12
	Per open mile	·25	·51	·14	·03	2·10	·60	1·26	...	4·67	
158	Eastern Bengal	43	117	12	10	316	68	64	192	779	
	Per open mile	·27	·74	·07	·06	2·00	·43	·40	1·21	4·93	
109	Sindh Railway	25	44	...	10	237	18	317	...	626	6
	Per open mile	·22	·40	...	·09	2·17	·16	2·90	...	5·74	

* Exclusive of 49 ghaut tank engines. † Includes 20 composite incline brakes.

TABLE C.

Table showing probable Difference in Time between Side and End Loading, and Composition of Trains both for Broad and Metre Gauge, compiled from Sub-Committee Reports.

	Time of Embarkation.				Number of Vehicles.			Number of Trains.		Order of Vehicles.	Time of Disembarkation.			
	Ordinary.		*End loading.*								*Ordinary.*		*End Loading.*	
Regiment of Native Infantry ...	¾	...	1	...	†44	7 3rd ,, ... 1 Double-horse ... 1 Single ... 8 Covd. wagons ... 1 Powder van ... 2 Brakes ...	.....	1	...	Ditto	¾	...	1	...
One Company of Sappers and Miners ...	...	...	...	...	†11	1 1st class ... 3 2nd ,, ... 2 3rd ,, ... 2 Covered vans ... 1 Powder van ... 2 Brakes ...	.....	...	...	...	...	...	⋮	...
Pontoon Train (one unit) ...	‡ 1	‡ 1	...	...	83	2 Composite ... 4 3rd class ... 34 Low-sided ... 38 Cattle trucks ... 1 Powder van ... 4 Brakes ...	126 — 2 Composite ... 6 2nd class ... 39 Low-sided ... 74 Cattle trucks... 1 Powder van ... 4 Brakes ...	2	2	...	...	...	...	...
Telegraph Train (one unit) ...	‡ ¾	‡ ¾	...	...	51	2 Composite ... 6 3rd class ... 18 Low-sided ... 20 Cattle trucks ... 1 Powder van ... 4 Brakes ...	73 — 2 Composite ... 6 3rd class ... 21 Low-sided ... 29 Cattle vans ... 1 Powder van ... 4 Brakes ...	2	2	...	...	...	...	...

* Troop of 80 horses only unsaddled. † Q. M. G. return of Units. ‡ For one train conveying half unit.

TABLE C.

Table showing probable Difference in Time between Side and End Loading, and Composition of Trains both for Broad and Metre Gauge, compiled from Sub-Committee Reports.

	Time of Embarkation.				Number of Vehicles.		Number of Trains.		Order of Vehicles.	Time of Disembarkation.			
	Ordinary.		*End loading.*							*Ordinary.*		*End Loading.*	
	Broad.	Metre.	Broad.	Metre.	Broad.	Metre.	Broad.	Metre.		Broad.	Metre.	Broad.	Metre.
	Hrs.	Hrs.	Hrs.	Hrs.						Hrs.	Hrs.	Hrs.	Hrs.
Battery of Heavy Artillery ...	4½	0	3	0	102 { 1 1st class ... 3 2nd ,, ... 4 3rd ,, ... 22 Open sided ... 9 Covered Goods... 3 Horse-boxes ... 48 Cattle trucks ... 6 Brakes ... 6 Low-sided ... }	.....	3	0	Baggage ... Men ... Guns ... Carriages ... Powder ...	2	...	1½	...
Battery of Horse Artillery ...	2½	0	2	0	84 { 1 1st class ... 5 2nd ,, ... 5 3rd ,, ... 33 Double horse ... 16 Cattle trucks ... 6 Covered goods ... 12 Open ... 6 Brakes ... }	134 { 1 1st class ... 7 2nd ,, ... 6 3rd ,, ... 63 Horse-boxes ... 18 Cattle trucks ... 17 Covered goods ... 16 Open trucks ... 6 Brakes ... }	3 or 2	3	Horses ... Men ... Guns ... Baggage ... Cattle ...	2½	...	1½	...
Battery of Field Artillery ...	3	0	1½	0	67 { 1 1st class ... 5 2nd ,, ... 5 3rd ,, ... 20 Horse-boxes ... 11 Cattle-vans ... 12 Low-sided ... 9 Covd. wagons ... 4 Brakes ... }	131 { 1 1st class ... 7 2nd ,, ... 8 3rd ,, ... 40 Horse wagons ... 19 Cattle vans ... 28 Low-sided ... 22 Covered ... 6 Brakes ... }	2	3	Baggage ... Men ... Horses ... Guns ... Ammunition ...	1½	...	½	...
Battery of Mountain Artillery...	2	3	1	¾	39 { 28 Covered goods ... 2 Horse-boxes ... 1 Saloon ... 3 2nd class ... 3 3rd ,, ... 2 Brakes ... }	88 { 72 Covered goods 1 1st class ... 4 2nd ,, ... 5 3rd ,, ... 6 Brakes ... }	1	3	At pleasure ...	1	¾	½	½
Regiment of British Cavalry ...	...	...	*1	...	†172 { 2 1st class ... 15 2nd ,, ... 17 3rd ,, ... 94 Double-horse ... 23 Cattle vans ... 24 Covered goods ... 1 Powder van ... 6 Brakes ... }	.....	3	...	...	...	...	* ¼	...
Regiment of Native Cavalry ...	...	...	* ⅝	...	†139 { 1 1st class ... 1½ 2nd ,, ... 5 3rd ,, ... 80 Double-horse ... 24 Cattle vans ... 8 Covered vans ... 1 Powder van ... 6 Brakes ... }	.....	3	...	...	...	...	* ¼	...
Regiment of British Infantry ...	1	...	1¼	...	†100 { 2 1st class ... 28 2nd ,, ... 26 3rd ,, ... 1 Double-horse ... 2 Cattle vans ... 3½ Covered vans ... 1 Powder van ... 6 Brakes ... }	.....	3	...	Ammunition and camp equipage in rear.	1	...	1¼	...
Regiment of Native Infantry ...	¾	...	1	...	†44 { 1 1st class ... 23 2nd ,, ... 7 3rd ,, ... 1 Double-horse ... 1 Single ... 8 Covd. wagons ... 1 Powder van ... 2 Brakes ... }	.....	1	...	Ditto	¾	...	1	...
One Company of Sappers and Miners ...	...	...	...	...	†11 { 1 1st class ... 3 2nd ,, ... 2 3rd ,, ... 2 Covered vans ... 1 Powder van ... 2 Brakes ... }	.....	...	...	...	...	...	⋮	...
Pontoon Train (one unit) ...	‡ 1	‡ 1	...	...	83 { 2 Composite ... 4 3rd class ... 3½ Low-sided ... 38 Cattle trucks ... 1 Powder van ... 4 Brakes ... }	126 { 2 Composite ... 6 2nd class ... 39 Low-sided ... 74 Cattle trucks... 1 Powder van ... 4 Brakes ... }	2	2	...	...	...	...	...
Telegraph Train (one unit) ...	‡ ¾	‡ ¾	...	...	51 { 2 Composite ... 6 3rd class ... 18 Low-sided ... 20 Cattle trucks ... 1 Powder van ... 4 Brakes ... }	73 { 2 Composite ... 6 3rd class ... 21 Low-sided ... 29 Cattle vans ... 1 Powder van ... 4 Brakes ... }	2	2	...	...	...	...	...

* Troop of 80 horses only unsaddled. † Q. M. G. return of Units. ‡ For one train convoying half unit.

TABLE D.

Statement showing the Vehicle Strength of an Unit of Pontoon and Telegraph Equipment, with Weights and Dimensions.

PONTOON TRAIN.

One unit sufficient for 100 *yards of bridge.*

Description.	Number.	Number of Wheels	Outside Dimensions.										Weight.		
			Length without poles.		Width.		Height.		Width of Track.		Distance apart of axles.				
			Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Cwt	qrs.	lbs.
Pontoon wagons	16	4	22	0	6		7	7	5	8	10	0	32	0	6
Trestle ,, ...	5	4	18	10	6	10	6	0	5	9	10	0	32	3	0
Chess Carts	21	2	10	0	6	6	6	6	5	2	...		20	0	0
Store carts	5	2	7	5	6	4	7	3	5	2	...		variable.		
Total	47														

TABLE E.

TELEGRAPH WAGON TRAIN.

One unit sufficient for 36 *miles of wire.*

Description.	Number.	Number of Wheels.	Outsidr Dimensions.										Weight.		
			Length without poles.		Width.		Height.		Width of Track.		Distance apart of axles.				
			Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Cwt	qrs.	lbs.
Wire wagons	12	4	13	7	6	4	6	4	5	2	7	5	30	2	0
Office ,, ...	4	4	11	8	6	4	9	0	5	8	6	0	23	0	20
Store carts	3	2	7	5	6	4	7	3	5	2	...		variable.		
Total	19														

Statement showing the Authorised Strength equipped for Service of—
One Unit of Pontoon Train,
One Unit of Telegraph (Wagon) Train,
One Unit of Telegraph (Mule) Train,
with the Proposed Distribution into Divisions for the purpose of Transport, and the Vehicle Accommodation required for each on a Railway, whether Broad or Narrow Gauge.

TABLE F—Pontoon Train.

Strength.	Divisions.		Description of Rolling Stock.	Broad Gauge.		Narrow Gauge.	
	A.	B.		A.	B.	A.	B.
Royal Engineer Officers	1	1	Composite	1	1	1	1
British Non-Commd. Officers and Medical	4	3					
Native Officers	1	1					
Non-Commd. Officers, Rank & File	57	57	3rd Class	2	2	3	3
Native Followers...	30	29					
Bullock Sirdárs	2	3	*With their Cattle.*				
,, Drivers	55	55					
Pontoon wagons	8	8	Low-sided open goods	8	8	8	8
Trestle ,, ...	3	2		3	2	3	2
Chess carts	10	11		4	4	5	6
Store ,, ...	2	3		1	2	2	3
	Mds.	Mds.					
Ammunition	Nil.	30	Powder van ...	...	1	1	...
Tents	49	61	Low-sided open goods	1	1	1	1
Equipment	53	53	Brakes	2	2	2	2
Baggage...	95½	98½					
Horses	1	1	Cattle trucks ...	19	19	37	37
Bullocks...	110	110					
			Total Vehicles ...	41	42	63	63

TABLE G—Telegraph Wagon Train.

Royal Engineer Officers	2	2	Composite	1	1	1	1
British Non-Commd. Officers and Medical	7	6					
Native Officers	1	1					
Non-Commd. Officers, Rank & File	57	57	3rd class	3	3	3	3
Native Followers	38	36					
Bullock Sirdárs	2	2	*With their Cattle.*				
,, Drivers	28	27					
Wire wagons	6	6	Low-sided open goods	6	6	6	6
Office ,, ...	2	2		1	1	2	2
Store carts	2	1		1	1	2	1
	Mds.	Mds.					
Ammunition	Nil.	30	Powder van ...	...	1	...	1
Tents	78	71	Low-sided open goods	1	1	1	1
Equipment	53	53					
Baggage	99	95	Brakes	2	2	2	2
Horses	2	2	Cattle trucks ...	10	10	20	19
Bullocks...	56	54					
			Total Vehicles ...	25	26	37	36

TABLE H—Telegraph Mule Train.

Strength.	No.	Broad and Narrow Gauge.	
		Description of Rolling-Stock.	No.
Royal Engineer Officers	1	Composite	1
Non-Commissioned Officers	1	3rd class	1
Rank and File	18	*With their cattle*	
Followers	12		
Mule Drivers	13		
	Mds.		
Tents	20	Low-sided open goods ...	1
Equipment ... —	27	Brake	1
Baggage	33	Cattle trucks	2
Mules	13	Total vehicles ...	6

TABLE J.

Return, showing the Number of Passenger and Goods Vehicles that were available on the 31*st December*, 1874, *on the Broad Gauge Indian Railways, then in communication with one another.*

Broad Gauge Railways.	PASSENGER.											Remarks.
	First class.	Composites.	Second class.	Hospital ambulance.	Intermediate.	Third class.	Post Office.	Brake-vans.	Fourth class.	Prison vans.	Total passenger.	
Sindh Punjab and Delhi	18	34	39	1	8	225	13	68	...	2	408	*Stock available with slight modification.*
East Indian, Main ...	75	18	86	3	74	323	24	99	...	...	702	For men ... ... 14,349 ,, horses ... 3,789 ,, wagons & guns 7,280 ,, special purposes 1,745 27,16
Oudh and Rohikhand	19	19	...	...	...	183	...	34	...	...	255	
State Railways ...	3	3	8	...	...	30	...	9	5	...	58	
Eastern Bengal ...	12	12	7	...	...	24	3	12	59	...	129	
East Indian Jubbulpore	8	4	14	...	4	30	4	18	...	...	82	
Great Indian Peninsula	83	72	152	6	...	365	19	404	83	...	1,184	
Bombay and Baroda	16	18	29	...	...	118	3	30	...	...	214	
Madras	9	38	56	2	...	181	24	43	40	...	403	
South Indian ...	...	7	2	...	...	34	...	8	...	...	51	
	253	225	393	12	86	1,513	90	725	187	2	3,486	

TABLE J.—Continued.

Broad Gauge Railways.	GOODS.																	
	Covered goods.	Open-sided covered goods.	Cattle wagons.	Horse-boxes.	Luggage vans.	Brake-vans.	High-sided open.	Low-sided open.	Coke.	Timber.	Platform.	Carriage.	Sheep.	Coal hopper.	Powder vans.	Miscellaneous.	Ballast wagons.	Total.
								*		*	*	*					*	
S. P. & D.	1,555	...	...	28	...	...	90	399	...	10	50	15	...	1	11	...	...	2,567
E. I., Main	3,169	...	43	61	16	125	...	986	84	115	54	35	1	1,151	25	17	...	6,566
O. and R.	542	...	6	9	...	...	67	120	...	93	...	...	5	...	4	...	...	1,101
State Railways	247	79	1	3	...	...	25	13	...	2	...	3	...	...	...	86	...	517
Eastern Bengal	315	...	4	6	...	...	68	...	...	13	...	4	...	...	1	192	47	779
E. I., Jubbulpore	634	...	10	14	4	28	...	182	22	12	14	4	...	...	6	4	...	1,016
G. I. Peninsula	3,072	...	133	93	...	...	401	2,521	5	140	...	27	...	...	17	...	280	7,873
B. and Baroda	928	...	112	15	...	43	27	1,537	...	55	...	6	113	...	6	...	...	3,056
Madras	48	...	35	50	...	60	1,857	282	288	141	...	30	...	...	3	...	...	3,300
South Indian	175	...	...	3	...	4	50	50	...	4	...	1	...	...	...	...	50	388
	10,685	79	344	282	20	260	2,587	6,072	499	588	118	125	119	1,152	73	299	377	27,163

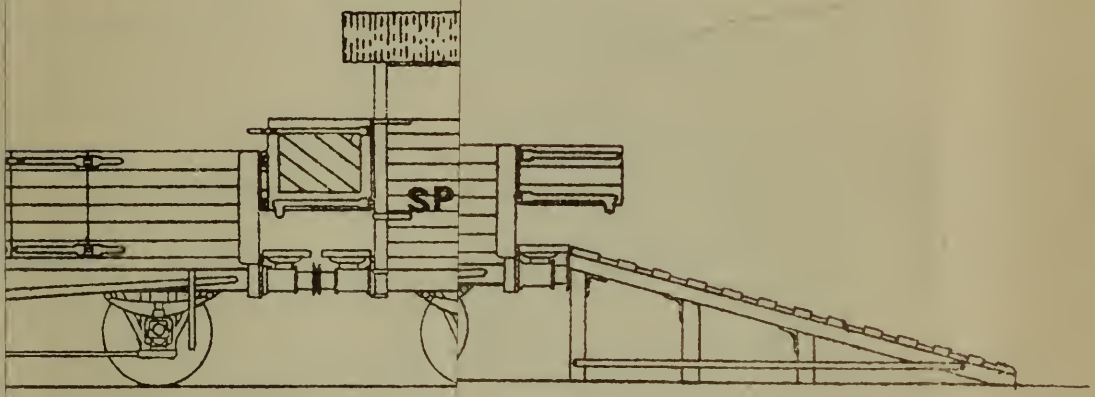
Columns marked thus (*) are recommended for end loading. Total, 7,162 vehicles.

PLATE I.

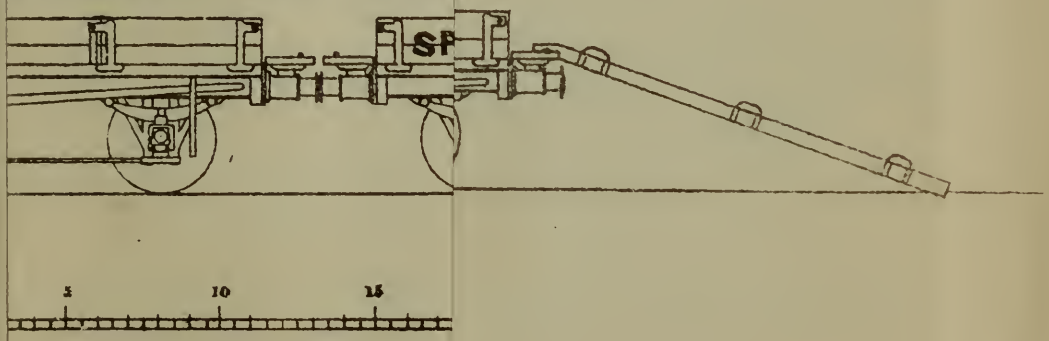
IIGH AND LOW PURPOSES,

LIEUTENANT-GE

ANGEMENT FOR LOADI



ANGEMENT FOR LOADI

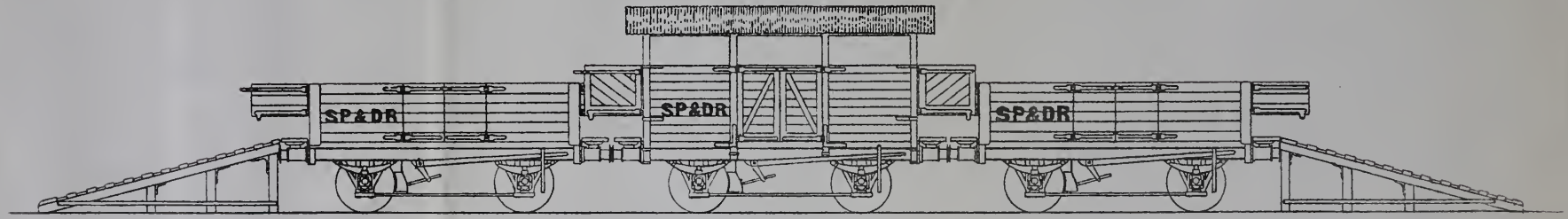


ALTERATION OF HIGH AND LOW SIDED WAGONS FOR MILITARY PURPOSES,

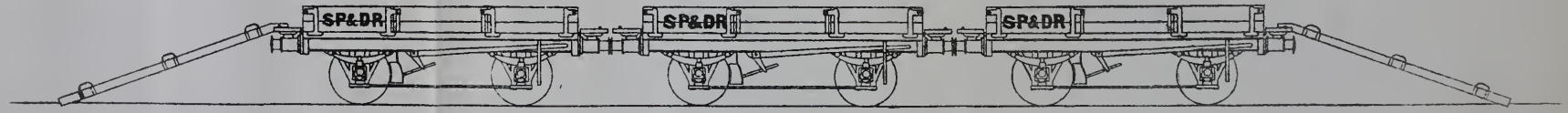
PROPOSED BY

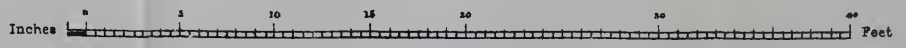
LIEUTENANT-GENERAL SIR CHARLES REID, K.C.B.

ARRANGEMENT FOR LOADING HORSES ON THE LINE OR IN A SIDING



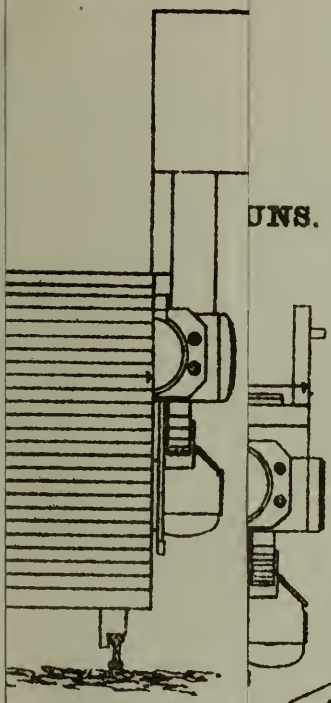
ARRANGEMENT FOR LOADING GUNS &c. ON THE LINE OR IN A SIDING



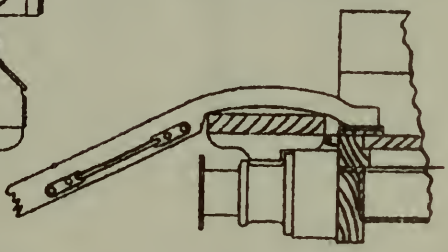


ING HORSES.

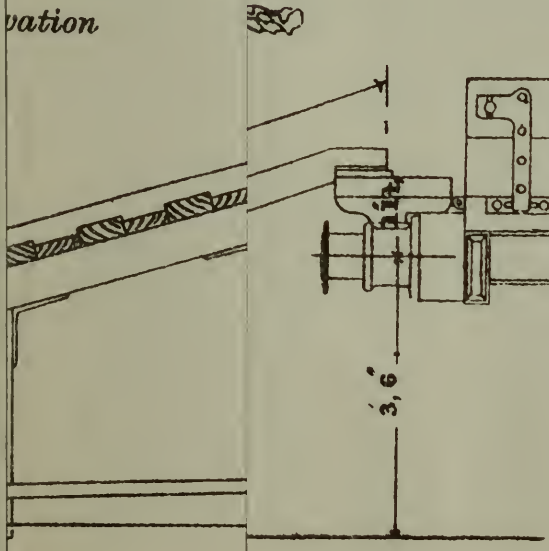
UNS.



Proposed Alteration



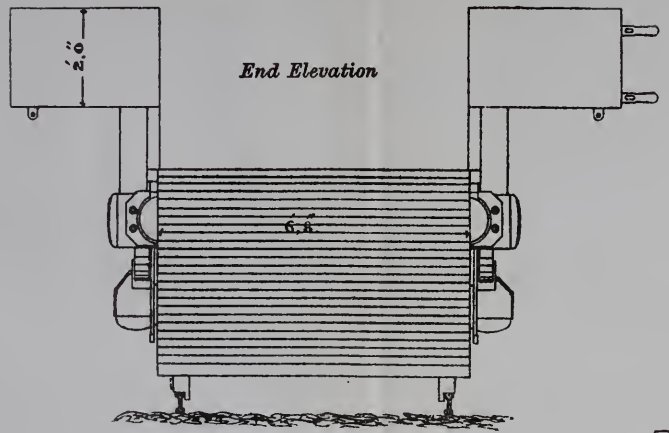
vation

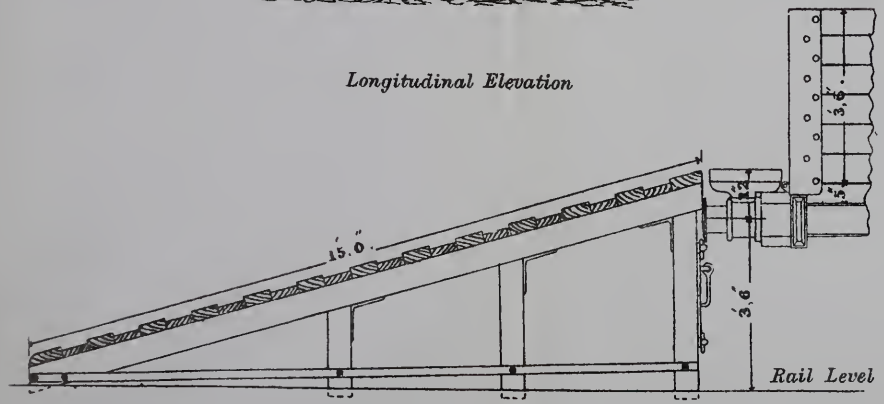


S P & D R

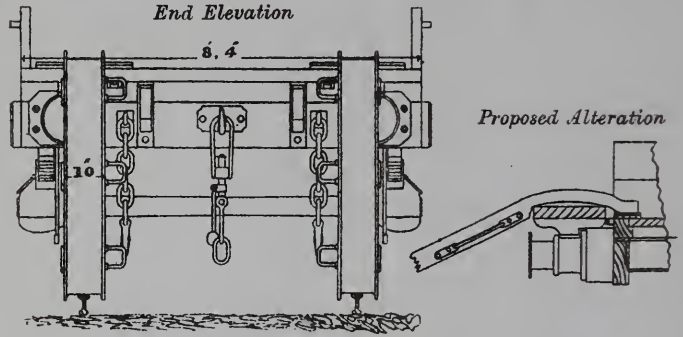
RAMPS FOR MILITARY TRAIN.

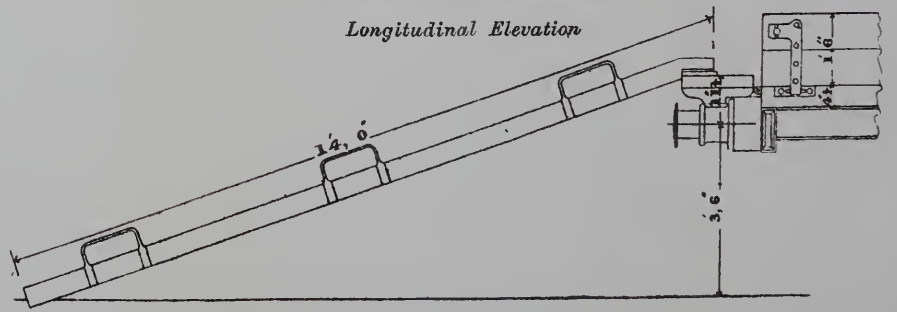
RAMPS USED FOR LOADING HORSES.



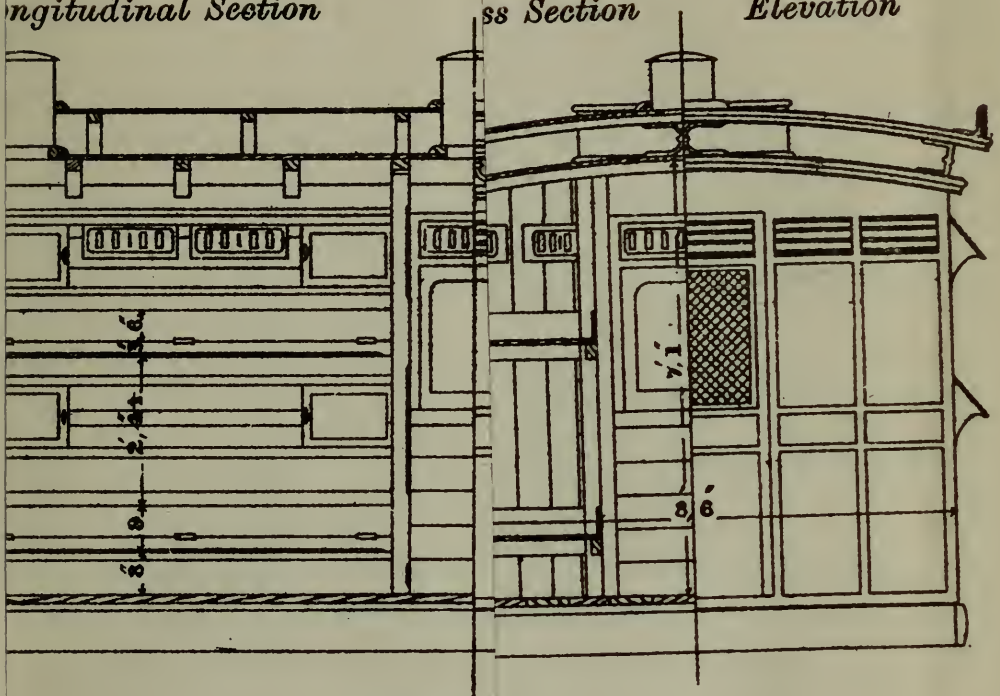


GIRDERS USED FOR LOADING GUNS.

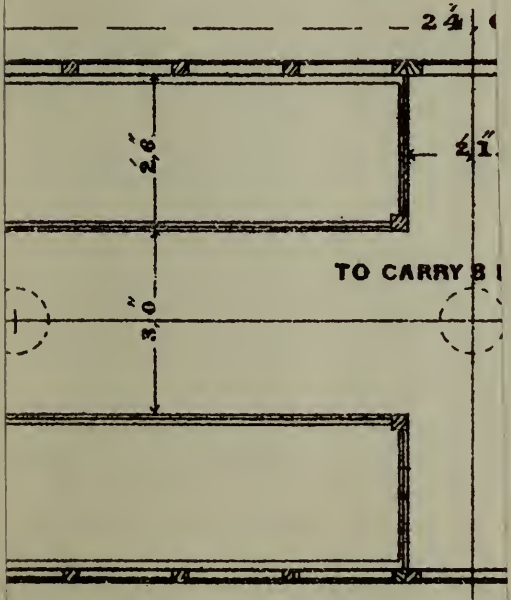




ngitudinal Section *ss Section* *Elevation*



Sectional



S P & D R

HOSPITAL CARRIAGE.

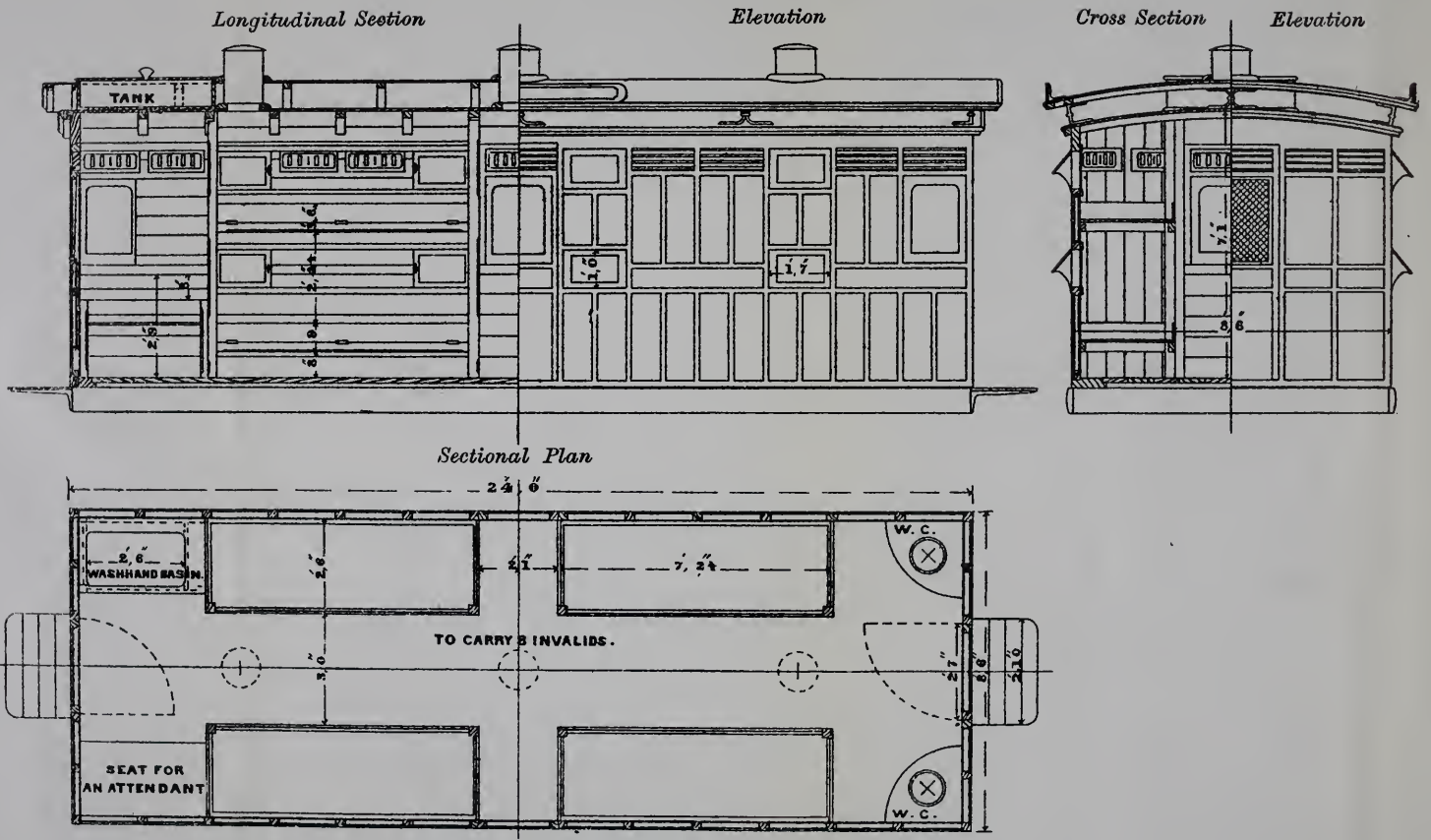
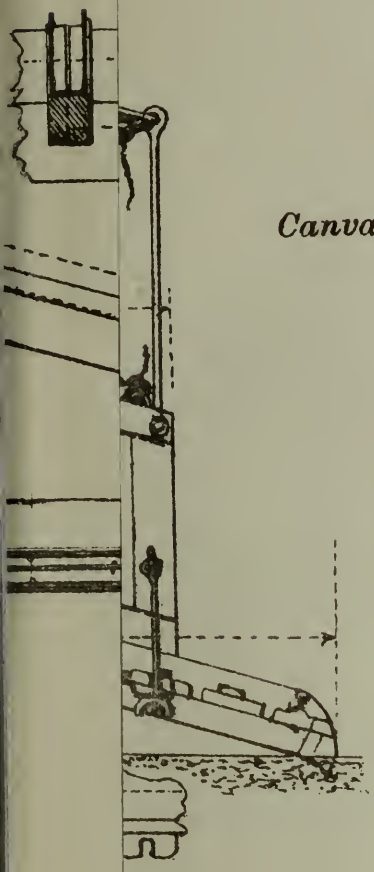


PLATE 4.

ABLE RAMP

ry. ading Horses

NCH PATTERN



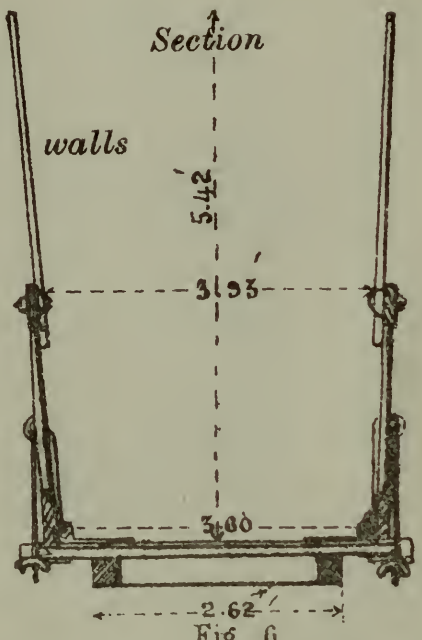


Fig 6

GIRDERS
For Field Artillery.
FRENCH PATTERN
(Longrines.)

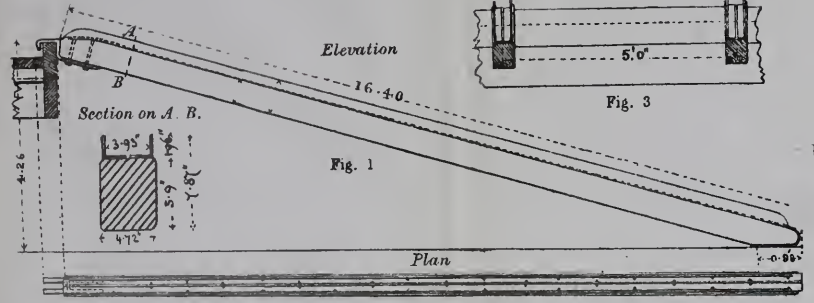


Fig. 2

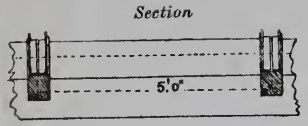


Fig. 3

PORTABLE RAMP
For Loading Horses
FRENCH PATTERN

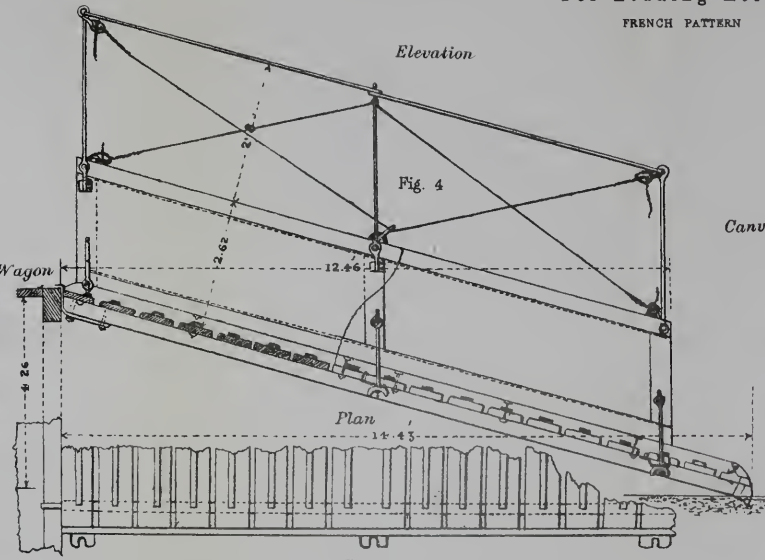


Fig. 5

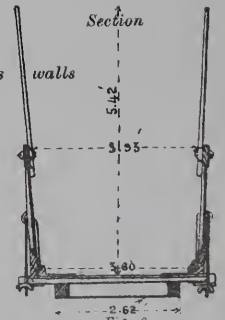


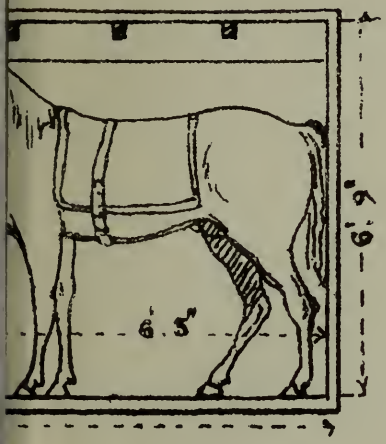
Fig. 6

BROA

TRANSPO

(from

INE



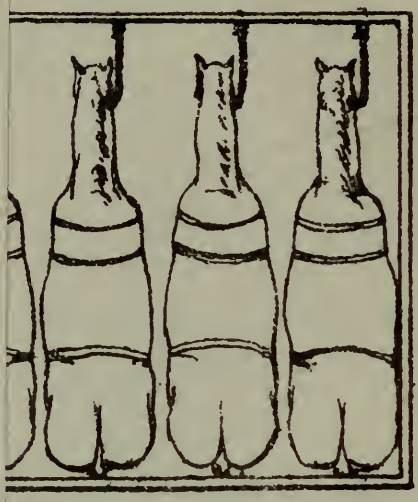


Fig. 7

Hanging Seat

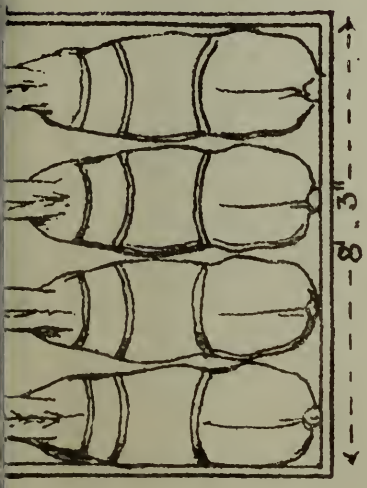
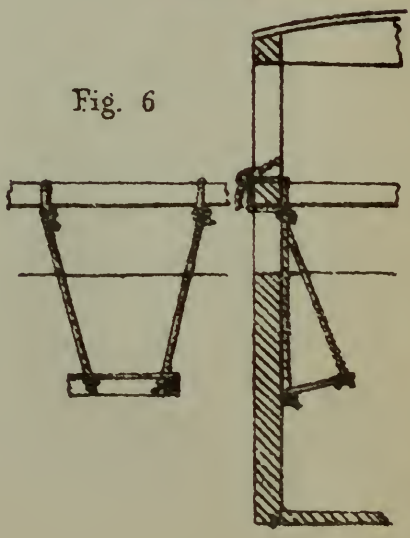


Fig. 6



BROAD GAUGE

TRANSPORT OF HORSES

(from the French.)

Fig. 1

PARALLEL TO THE LINE

(Longitudinal)

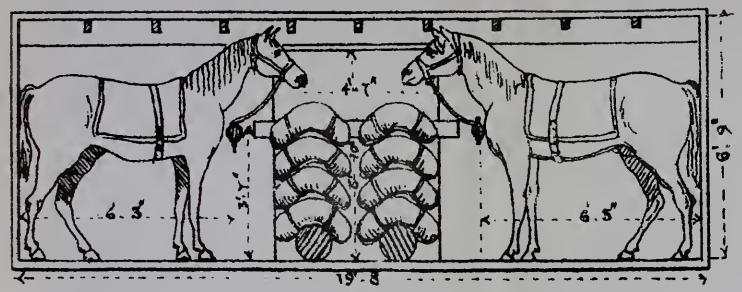


Fig. 4

AT RIGHT ANGLES TO THE LINE

(Transverse)

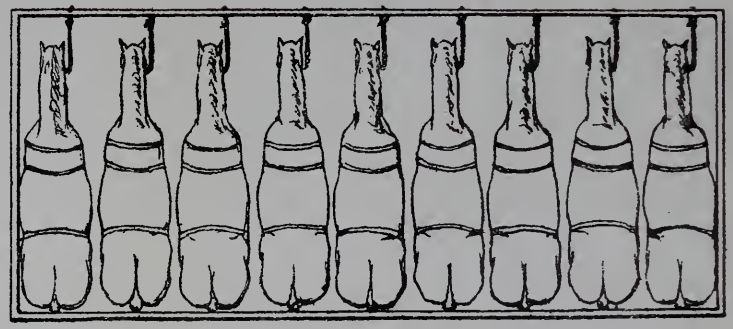


Fig 2

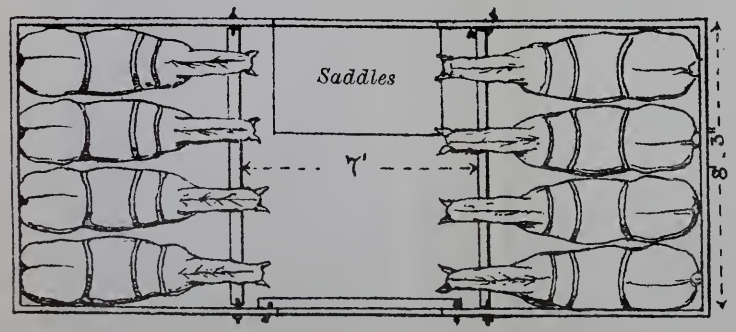


Fig. 3

Cross Section of Fig 1

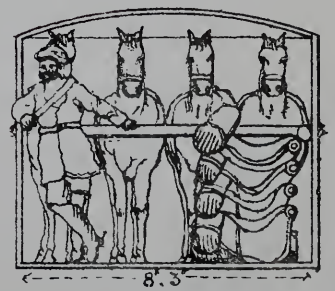


Fig 5

Cross Section of Fig 4

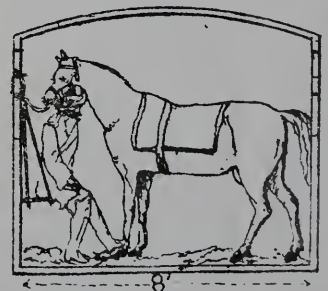
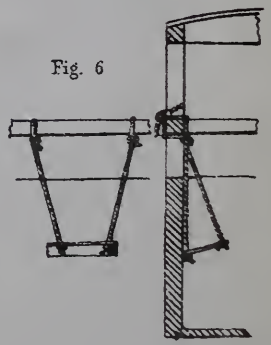


Fig. 7

Hanging Seat

Fig. 6



THE ORGANISATION OF THE IMPERIAL RUSSIAN ENGINEERS.

Translated by Captain J. Gore Booth, R.E.

From the 'Organ der Militär-wissenschaftlichen Vereine,' 1877.

By the new organisation, by this time carried out in the Engineers, this body is increased to four active Sapper battalions, four Railway and two Pontoon battalions; further by one Pontoon company, three Field Telegraph and three Field Engineer parks; besides, in war time, twenty reserve Sapper companies and five Ersatz Sapper battalions are raised.

At the same time the several parts are raised to a greater strength.

According to this the Russian Engineer forces and establishments stand in peace and war at—

1 battalion of Sappers of the Guard.
1 Grenadier Sapper battalion.
13 battalions of Sappers of the Line.
1 Turkestan Sapper company.
4 Railway battalions.
8 Pontoon „
1 Caucasian Pontoon company.
1 Instruction Company for Electricity.
9 Field Telegraph parks.
5 Field Engineer parks.
2 Siege Train parks.
2 Submarine Mining companies.

Also, in addition, in war time—

2 Reserve companies of Sappers of the Guard.
2 „ „ of Grenadiers.
16 „ „ of Line.
5 Ersatz Sapper battalions.

As regards the military administration, the Engineer troops and establishments in peace time form five brigades of Sappers, which are

commanded by major-generals or lieutenant-generals as chiefs of brigades, with the rank of chief of division. These brigades are—

1st Sapper Brigade.

(Staff in St. Petersburg.)

Sapper Battalion of the Life Guard.
„ „ „ Grenadiers.
No. 1 „ „ „ Line.
„ 1 Railway Battalion.
Nos. 1 & 2 Pontoon Battalions.
„ 1 & 2 Field Telegraph Parks.
No. 1 Engineer Park.

2nd Sapper Brigade.

(Staff at Riga.)

Nos. 2, 3, & 4 Battalions of Sappers of the Line.
No. 2 Railway Battalion.
Nos. 3 & 4 Pontoon Battalions.
„ 3 & 4 Field Telegraph Parks.
No. 2 Engineer Parks.
„ 1 Engineer Siege Train Park.

3rd Sapper Brigade.

(Staff at Kief.)

Nos. 5, 6, & 7 Battalions of Sappers of the Line.
No. 3 Railway Battalion.
Nos. 5 & 6 Pontoon Battalions.
„ 5 & 6 Field Telegraph Parks.
No. 3 Engineer Park.
„ 2 Engineer Siege Train Park.

4th Sapper Brigade.

(Staff at Warsaw.)

Nos. 8, 9, & 10 Battalions of Sappers of the Line.
No. 4 Railway Battalion.
Nos. 7 & 8 Field Telegraph Parks.
No. 4 Engineer Park.

Caucasian Sapper Brigade.

(Staff at Tiflis.)

Nos. 1, 2, & 3 Caucasian Sapper Battalions.
Caucasian Pontoon Company.
„ Field Telegraph Park.
„ Engineer Park.

Also the following without any brigade organisation:—With the troops in Turkestan, the Turkestan Sapper Company; at the Technical Electrical Establishment, the Electrical Instruction Company, and the similar Torpedo Company.

During war time the brigade staffs remain at their stations while the Engineer troops and establishments are told off to the operating armies as required.

Respecting the raising of the two Pontoon battalions, the Caucasian Pontoon company, and the three Field Engineer parks, recently decided on, as well as Nos. 1, 2, and 4 projected Railway battalions, special orders are issued.

DETAIL FORMATION.

1.—The Active Sapper Battalions.

All the Sapper battalions carry, besides, in the order of battle distinct appellations and numbers, and consist in peace of five companies. In war time one company is taken off the cadre for the formation of the Reserve Sapper company and the Ersatz Sapper battalion, and the battalion takes the field only 4 companies strong.

The war strength of a battalion is 900 rank and file (one-half sappers and the other half miners), of whom 216 men per company are armed with the Berdan breechloaders, and 9 men without arms are held in reserve for the interior economy &c.

At peace strength each battalion has 600 rank and file, of whom 112 men per company are armed and 8 unarmed. The strength of under-officers corresponds to that of the rank and file, so that one under-officer is reckoned to ten of both.

The fighting strength of a Field Sapper company is as follows:—

Armed with Revolvers:—	In War	In Peace
Captain	1	1
Lieutenant	1	1
Sub-Lieutenant	1	1
Ensign (Fähnrich)	1	1
Sergeant-Major (Feldwebel)	1	1
Quartermaster-Sergeant (Capitän d'armes)	1	1
	6	6

	In War	In Peace
Brought over	6	6
Armed with Rifles:—		
Section Sergeants (Zugsunterofficiere)	4	4
Junior „ (Jüngere-unterofficiere)	14	8
Volunteers (Freiwillige)	4	4
Corporals	20	16
Privates	196	96
Drummers (with revolvers)	2	2
Privates unarmed	9	8
Total	255	144
Of above, armed with firearms	238	128

Of the Battalion Staff there are reckoned as fighting strength:—

Armed with Revolvers:—		In War	In Peace
The Battalion Commandant (in the Guard, Major-General, in others Colonel)		1	1
Junior Staff Officers (in the Guard, Colonel, in others Lieutenant-Colonel, for the administration)		1	1
Battalion Adjutant	1 Captain and 3 Battalion Officers.	1	1
Paymaster (Zahlmeister)		1	1
Quartermaster		1	1
Arms Officer (Waffenoffizier)		1	1
In addition Subaltern Officers		2	2
Battalion Drum-Major (Under-Officer)		1	1
„ Trumpet-Major (Under-Officer)		1	1
Total		10	10

Of Non-Combatants (Officers).

Senior Physician		1	1
Junior Physician		1	1
Assistant Paymaster (Rechnungsführer)		1	1

Men.

Battalion Quartermaster-Sergeant (Under-Officer)		2	2
Clerk (Schreiber)	„	7	8
Hospital Sergeant (Feldscheere)		6	12
Farrier Sergeant		1	0
Overseer of Sick (Krankenaufseher)		1	1
Hospital Attendants		4	5
Master Gunsmith (Officer or Under-Officer)		1	1
Assistant-Master Gunsmith		2	2
Armourers		1	1
Joiner (Schifter)		1	1
Master Carpenter	Under-Officers	1	1
Collar Maker		1	1
Master Blacksmith (Metallarbeiter)		2	2
Cutter out (Vorschneider)		1	1
Armour Fitter (Armaturanpasser)		1	1
Trains:—			
Under-Officers		3	1
Privates		27	10
Officers' Servants		30	34
Total Non-Combatants		95	87

	In War	In Peace
Officers' Riding Horses	10	3
Troop Riding Horses	5	1

In addition, the 1st Sapper Battalion in each Sapper brigade (as in the Guard, the 2nd, 5th, and 8th Army, and also the Caucasian Sapper Battalion) has a band at the head-quarters, which, with the exception of the musical instructor, belongs to the war strength, and is of the following strength:—

	In Guard Battalions	In the Four Line Battalions
Musical Instructor	1	—
Drum-Major	1	—
Musicians with Revolvers:—		
Senior Under-Officers	1	1
Junior „	11	11
Privates	30	28
Pupils	12	12
Total	56	52

The Turkestan Sapper Company has retained its previous state, which is shown in the table at the end.

2.—The Reserve Sapper Companies.

On the transfer of the Engineers to a war footing, the 5th companies of the Sapper battalions of the Guard and Grenadiers, 3rd, 5th, 6th, 8th, 9th, and 10th Sapper battalions of the Line, and the 4th companies of the 1st and 2nd Caucasian Sapper battalions, are detached, and formed into the 2nd Reserve Sapper companies.

The Guard and Grenadier Reserve Sapper companies carry the numbers 1 and 2; but the Army Reserve Sapper companies, from the above-mentioned Sapper battalions of the Line, the numbers 1 to 16.

These companies are told off in war time for service in fortresses, on roads in rear of operating armies, and to strengthen Engineers employed in sieges.

The normal war strength of a Reserve Sapper company, without volunteers, is equal to that of a Service company in war time, with the addition of several non-combatants, which are noted in the table at the end.

3.—The Ersatz Sapper Battalions.

The Ersatz Sapper battalions are formed in war time from companies chosen at will from the 1st, 2nd, 4th, and 7th Sapper battalions

of the Line, and also from the three Caucasian Sapper battalions, which are detached as cadre, at the discretion of the Inspector-General of Engineers, from the brigades.

The Ersatz Sapper battalions receive their numbers according to the numbering of the five Sapper brigades—1, 2, 3, 4, and Caucasian Ersatz Sapper battalion.

Each battalion consists of four companies, with a fixed cadre, and a changeable or temporary strength.

To the fixed cadre strength belong the instructors for the men on furlough and recruits.

On the temporary strength are the Reserve officers and men who are determined on for the next ballot for completing the active Reserve and other Engineer troops and establishments in the field.

The above-mentioned strengths are for an Ersatz battalion in war time, thus :—

Fighting Strength.

Staff and Officers.

	Strength		
	Fixed	Temporary	Together
Armed with Revolvers :—			
Battalion Commandant (Colonel)	1	—	1
Junior Staff Officer (Lieutenant-Colonel)	—	1	1
Captains	4	1	5
Lieutenants	3	4	7
Sub-Lieutenants	—	5	5
Ensigns	—	5	5
Total	8	16	24

Rank and File.

With Revolvers :—			
Sergeant-Major	1	3	4
Quartermaster-Sergeant	1	3	4
With Rifles :—			
Section Under-Officers	8	8	16
Junior ,,	8	48	56
With Revolvers :—			
Battalion Drummer	—	1	1
Company ,,	2	6	8
Battalion Trumpeter	—	1	1
With Rifles :—			
Corporals	16	48	64
Privates	104	732	836
Total	140	850	990
Of these with firearms	—	—	936

NON-COMBATANTS.

	Strength		
Officers.	Fixed	Temporary	Together
Senior Physicians	—	1	1
Junior „	—	1	1
Assistant Paymaster	1	—	1
Total	1	2	3
Men.			
Battalion Quartermaster-Sergeant	—	2	2
Clerks	1	6	7
Hospital Sergeants	1	5	6
„ Superintendent	—	1	1
„ Orderlies	1	3	4
Master Gunsmith	—	1	1
Assistant-Master Gunsmith	—	2	2
Gunsmith and Joiner (Schifter)	1	1	2
Master Carpenter	—	1	1
„ Blacksmith	1	1	2
Cutter-out (Vorschneider)	1	—	1
Armour Fitter	1	—	1
Train—Privates	—	8	8
Officers' Servants	10	20	30
Total	17	51	68
Officers' Riding Horses	2	—	2

As train each company has two 1-horsed waggons.

The Ersatz Sapper battalion can, in war time, be varied from the temporary strength according to circumstances.

The procedure regarding the calling in of men on furlough and recruits, and their instruction and despatch to the troops in the field, is modelled on that for the infantry.

The summary of all the technical troops is given in the table at the end.

EQUIPMENT OF THE ENGINEERS.

In war time the whole of the active Sapper battalions, as well as the Reserve Sapper companies, are equipped with the engineer tools suitable for the field and with transport for it; the Ersatz Sapper battalion, on the contrary, only with entrenching tools carried by the men. Conformably to this, the complete engineer equipment and transport for six, i.e. for four Field and two Reserve Sapper companies, is in peace time kept in store by each Sapper battalion which raises Reserve companies; and by the other Sapper battalions the complete equipment and transport for four companies, with the entrenching tools, carried by the men, for the fifth, to form the Ersatz battalion.

The further amount of equipment for the three spare Ersatz

companies is drawn by the Ersatz battalion from the nearest depôt of engineer material.

The organised train comprises—

	Active Battalion Staff	Field or Reserve company
4-horse Ammunition Waggon	—	1
4-horse Office „	1	—
4-horse Provision „	—	1
4-horse Paymaster's „ (Zahlmeister)	1	—
4-horse Artificers' „	1	—
4-horse Hospital Necessaries Waggon	1	—
4-horse Ambulance Waggon	1	—
4-horse Dispensary „	1	—
4-horse Engineer Tools „	—	2

Total in war in an active battalion, 22 carriages with 36 artillery (besides 4 reserve), and 60 light (besides 4 reserve) train horses. In peace time, of these carriages, only 5 provision waggons are horsed, with 3 train horses.

The officers' train in war includes:—

1 3-horsed equipage
1 2-horsed baggage waggon } for the commandants
3 2-horsed baggage waggons, of which one is for the staff, two for the companies.

Total, 5 vehicles, with 11 horses.

The train for the men consists in peace and war of two 1-horsed country carts per company for the mess.

As equipment to be carried by the men :—

By a Field Reserve and Ersatz Sapper company—

104 Steel shovels (helved)
72 Light hatchets „
10 Cramps (Krampen) „
20 Picks (Hauen) „
2 1-inch augers
2 ½- „ „
8 Pointed chisels (carpenters')
4 Tracing tapes, 21·3 m. long
2 Measuring tapes, 10·6 m. long.

In a Field and Reserve Sapper company, in the waggon—

40 Steel shovels (helved)
24 Light hatchets „
16 Heavy carpenters' hatchets „
5 Cramps (Krampen) „
5 Picks (Hauen) „
8 Cramps combined with picks „
4 10-lb. crowbars

2 15-lb. Pinching bars (Gaisfüsse)
1 10-lb. Mallet
1 15-lb. ,,
1 Fascine knife
1 ,, choker
2 Railway rail-keys
1 Circular grindstone
2 Whetstones
100 Sandbags
2 2½-lbs. Anchors, cable, and other iron component parts for bridges
1 Completely fitted galvanic battery.

In war the number of artillery horses required for a Field or Reserve Sapper company is—

1 riding horse
4 draught horses for the entrenching tool waggons
4 ,, ,, ,, galvanic battery waggons
1 reserve horse

Total 10 horses.

4.—The Railway Battalion.

Of the general rules for the employment of the Railway battalion, for the present only those are in use which were given in the War Minister's Order in 1870 (No. 89, of 25th March), for the contemplated appointment of railway commands in war, and were included in the Russian handbook for defence, 1871, page 54. A complete new strength for the Railway battalions can be there seen, but the data for the formation of the three Railway battalions in the active (South) army will be published hereafter.

According to the ministerial order issued in this case the battalion consists of two companies for the construction of railways and two for its working.

The companies are formed in war as the Field Sapper companies are, with the small difference that they include in their strength no volunteers, and that of the 225 rank and file composing the company, 208 men, or 104 files (Rotten), are armed with the Berdan rifle, and 17 men are in reserve unarmed.

The strength of the Battalion Staff differs from that of a Sapper battalion, in so far as in it one master armourer, one foreman of smiths, one master tailor, one armour fitter, are wanting, and only 18 men of the Train are attached.

In addition, in the battalion, 132 revolvers are carried for 44 engine-drivers, 44 assistants, and 44 stokers.

The distribution of the men for their special employment on the theatre of war depends on the actually existing requirements.

The 3rd Railway battalion, although belonging to the mobilisation of the 3rd Sapper brigade, is placed under the orders of the commander of the military roads section of the administration for the communications of the active army.

In addition to the commander alluded to, there are attached to the battalions by the Minister of the Interior for the communications—

For the Superintendence of Construction.

1 Engineer officer as Chief,
2 „ officers as Superintendents of Construction,
2 „ „ as their assistants, and
5 Engineers (Techniker).

For the Railway Management.

1 Engineer as Traffic Manager,
3 Engineers for the traffic service for keeping the line in order for rolling stock &c.,
3 Engineers as their assistants,
2 Permanent-way Superintendents (Strecken chefs),
1 Telegraph Superintendent,
1 „ Inspector, and
6 Officials as Secretaries.

The Intendance Train decided on for the Railway battalion consists of—

1	Cash and office waggon . .	4 horses
4	Provision waggons . . .	16 „
2	Artificers' „ . . .	8 „
1	Paymaster's waggon . .	4 „
1	Hospital „ . .	4 „
1	Apothecary's (Apotheker-plattform)	4 „

For Engineer Transport.

4	Service and artificers' waggons	16 „
2	Waggons with mining materials	8 „
	In reserve	5 „
16	Vehicles. Total .	69 horses.

The officers' baggage and the men's Mess Train are the same as in a Sapper battalion.

Although, in the orders, there is no later provision laid down for the equipment of the men, it must, however, be understood that they are provided with the necessary entrenching tools analogous to the Sappers.

As regards the formation and employment of the Railway battalion in peace time nothing definite is as yet decided on.

The war strength of the Railway battalion is shown in the table at the end.

5.—The Pontoon Battalions.

The Pontoon battalions have, as heretofore, only two companies, and receive, in addition, in war, a Train division, which is formed out of the cavalry men on furlough (Urlauberstande). These battalions have a war and peace strength.

The war strength consists of 318 rank and file, of which 152, or 76 files in a company, are armed with rifles and 7 unarmed, besides 132 rank and file of the Train division.

On the peace footing the battalions number 250 rank and file, of which 120 men, or 60 files per company, are armed and 5 unarmed. Therefore the fighting strength of a Pontoon company consists of—

	In War	In Peace
Company Commandant (Captain)	1	1
Subalterns	3	3
Sergeant-Major	1	1
Quartermaster-Sergeant	1	1
Section Under-Officer (Zugsunterofficiere)	4	4
Junior ,,	16	16
Volunteers	4	4
Drummers	2	2
Corporals	16	16
Privates	143	109
Total	191	157
Of these are armed with firearms	176	144

The fighting strength of the Train division for the bridging material consists of—

	In War	In Peace
Senior Troop Sergeant-Major (Wachtmeister)	4	—
Sergeants	8	—
Corporals	16	—
Privates	116	—
Total	144	—

As a Battalion Staff on fighting strength :—

	In War	In Peace
Battalion Commandant (Colonel)	1	1
Captain (for Administration)	1	1
Battalion Adjutant (Captain)	1	1
Paymaster, Quartermaster, and Superintendent of Arms (Lieutenant or Sub-Lieutenant)	1	1
Battalion Drum-Major	1	1
„ Trumpet-Major (Mounted)	1	1
Total	6	6

Of the Non-combatants :—

Officers.

Junior Physician	1	1
Veterinary Surgeon	1	—
Accountant	1	1

Men.

Battalion Master-of-Arms	2	2
Clerks	5	5
Hospital Sergeants	4	4
„ Pupils	—	2
Farrier Sergeants	2	—
Hospital Orderlies	4	2
Master Armourer	1	1
Assistant „	1	1
Joiner (Schifter)	1	1
Master Carpenters	6	4
„ Smith	10	6
Harness Makers	4	1
Cutters-out (Vorschneider)	1	1
Armour Fitter	1	1
Train Under-Officers for the Baggage Train	1	1
„ Men for the Baggage Train	9	3
Officers' Servants	16	15
Total	71	52

Equipment.—The Pontoon battalions, like the Sappers, are supplied with all entrenching tools, and, in addition, with a length of bridging material for 213 m. length of bridge.

The organised Train includes vehicles for Intendance :—

	Train Horses	
	In War	In Peace
2 Ammunition Carts	8	—
1 Cash and Office Waggon	4	—
2 Provision Waggons	8	6
1 Hospital necessaries Waggon	4	—
1 Ambulance Waggon	4	—
1 Apothecary's (Apotheker-Plattform oder Karren)	1	—
Reserve Horses	2	—
	31	6

For officers' baggage :—

1 3-horsed vehicle } for the Commandants.
1 2-horsed Baggage Waggon }
3 2-horsed Baggage Waggons for the Officers.

For the men :—

	Train Horses	
	In War	In Peace
4 1-horse ordinary country Mess Waggons.		

For Engineer Transport :—

58 6-horse Pontoon Waggons	348	—
Reserve horses	24	—
Total	372	
58 Vehicles with	—	8*

For riding horses in war time :—

For officers	12 horses
Under-officers	14 ,,

The entrenching tools for a Pontoon battalion are as follows :—

(*a*) Carried by the men.

126 Helved steel shovels
70 ,, light hatchets
20 ,, picks (Hauen)
10 Cramps (Krampen)
4 1-inch augers
4 ½- ,, ,,
16 Straight chisels (carpenters')
8 Tracing lines, 21·3 m. long
4 Measuring tapes, 10·5 m. long.

(*b*) Carried on waggons.

96 Helved steel shovels
60 ,, light hatchets
16 ,, heavy ,, (carpenters')
8 ,, cramps (Krampen)
20 ,, picks (Hauen)
20 ,, cramps and picks combined (Krampen mit Hauen)
8 15-lb. pinching bars (Gaisfüssen)
4 10-lb. mallets
4 Fascine chokers
8 Fascine knives
4 20-lb. weight circular grindstones
4 Whetstones
200 Sandbags.

* For practice in peace time.

In addition, with each battalion there is a complete set of miners' tools, the necessary fuses and explosive materials, and a completely equipped galvanic battery.

Bridging materials determined on :—

		Long	Wide	Deep
44	Front sections of pontoons	4·3 m.	× 1·85 m.	× ·73 m.
12	Middle „ „	3·48 m.	× 1·85 m.	× ·73 m.
2	Anchor boats	6·17 m.	× 1·76 m.	× ·84 m.

8 Trestles, 5·23 m. long, 16 × 23 cm. square, with 16 feet—5·03 m. long, 8 feet—3·80 m. long, and 8 feet—2·60 m. long.

Besides the pontoons the materials are loaded on the waggons as follows :—

32	Waggons	No. 1	the balks
4	„	„ 2	the trestles
12	„	„ 3	the chesses (Streuhölzer)
4	„	„ 4	Small stores and spare pieces
4	„	„ 5	Tools and heavy anchors
2	„	„ 6	Anchor boats and galvanic battery and apparatus.

6.—The Caucasian Pontoon Company.

This has an organisation similar to the Pontoon battalion. Its strength is 143 rank and file, of whom 136 men, or 68 files, are armed with rifles, and 7 unarmed.

The company has the same fighting strength in peace and war, and consists of—

1	Captain as Commandant
1	Captain as second Commandant
2	Lieutenants } one of whom is Adjutant
2	Sub-Lieutenants }
1	Sergeant-Major
1	Quartermaster-Sergeant
4	Section Under-Officers
8	Junior „
4	Volunteers
2	Company Drummers
16	Corporals
127	Privates

Total 169, of whom 152 have rifles.

Among the non-combatants, all the elements which are met with

in the Pontoon battalions are included. Further specifications are given in the table at the end.

In peace time the company has for train only one 1-horse waggon. No orders are promulgated as regards its equipment or bridging material in war.

7.—The Electrical Instruction Company.

This retains its former organisation, and is stationed at the technical electrical establishment at St. Petersburg.

At this establishment theoretical and practical instruction, according to the system of the technical electrical service of the Engineers and Field Establishments, is given to the Sapper officers for one or two years, and recruits are attached to a company appointed by the commanding officer as an Instruction Company, with which they go through a similar course.

The recruits yearly replaced in the Instruction Company receive in addition the instruction given previously for the Sappers.

The company, as regards the technical electrical establishment, is directly under the Engineer head administration (Director-General of Engineers) of the War Ministry.

During the summer the company encamps with the 1st Sapper Brigade on the Neva at St. Petersburg, for the purpose of practical exercise.

The Sapper officers instructed at the technical electrical establishment, after their relief, must undertake the technical electrical instruction of the men of their own division, and carry it on for at least a year. On the other hand, the soldiers, one to two men, passed out of the Electrical Instruction Company each year to the Sapper battalion and the parks, are employed in peace time by preference in looking after and keeping in order the electrical instruments.

The table shows the normal strength of the company.

8.—The Field Telegraph Park.

The 9 Field Telegraph parks are called (in European Russia) 1–8 Field Telegraph parks; in the Caucasus, Caucasian Field Telegraph park.

The Field Telegraph parks belong in peace to the Sapper Brigade, and move to the front in war, under the direction of the chief of the

general staff of that army corps to which they are attached. They have a war and peace footing. The fighting strength stands at—

	In War	In Peace
Park Commandant (Colonel or Lieutenant-Colonel)	1	1
Captains	3	3
Lieutenants (one of which is Adjutant)	2	1
Sub-Lieutenants	2	2
Sergeant-Major	1	1
Senior Telegraphists	12	12
Junior „	12	12
Examiner (Mechanician)	6	6
Section Under-Officers	12	—
Junior „	24	1
Corporals	36	3
Privates	182*	32*
Total	293	74

all armed with revolvers.

The non-combatants include—

Clerks	4	1
Hospital Sergeants	1	—
Farrier „	2	—
Train Under-Officers	6	1
„ Privates	60	1
Officers' Servants	9	8
Total	82	11

Matériel is measured for each Telegraph park at 107 kilometres (100 versts) of wire, and six telegraph stations with double apparatus. By setting up only one telegraph apparatus, the stations can be increased as required.

The *matériel* is carried on—

6 4-horse station (office) waggons, with apparatus, batteries, &c.

21 6-horse *matériel* waggons for the telegraph construction, arranged for 14 men to sit on.

3 4-horse reserve *matériel* waggons, seats for 10 men.

3 4-horse provision waggons.

The 30 first-named vehicles are horsed with 174 (of which 12 reserve) Artillery draught horses, but the provision waggons with 12 light Train horses.

* These should be of the following trades:—

	In War	In Peace
Painters	3	1
Collar Makers	1	1
Locksmiths	1	1
Wheelers	3	1
Smiths	6	1
Joiners	3	2
Total	17	7

The officers' baggage train consists of—

1 3-horse equipage
1 2-horse baggage waggon } for the Commandants.

1 2-horse baggage waggon for the Park officers, with 7 draught horses.

For the men's mess trains—

1 1-horse country cart.

The riding horses in war time are fixed at—

For officers	8 horses
„ Under-officers	6 „
Total	14

Designation.—The Field Telegraph parks are intended to set up and maintain telegraphic connection (Verbindung) between the operating army and the several army corps. The connection between the head-quarters and the base and the State telegraph lines in rear of the army is the function of a separate Field Telegraph division, which, in war time, is under the orders of the director of the Post and Field Telegraph section of the field administration for military communications with the army.

In general the Field Telegraph division has, in war time, to strengthen the staff of the State and private railway lines, to make new lines for war purposes, and to set them working; to repair quickly lines destroyed by the enemy, or to render useless those lines which may have fallen into the enemy's hands.

To fulfil these demands from the military force it is necessary that the Field Telegraph parks should, in peace, have uninterrupted education for a sufficient number of telegraphists and artificers, so that the Field Telegraph division in rear of the army, in its formation and completion, should suffer no loss by any such individuals.

To this end a sufficient number of intelligent, well-conducted soldiers who can write, and who have served at least a year, are taken by the Chiefs of the Sapper brigades, from the Sapper battalions, as telegraphists and artificers, and transferred to the Telegraph parks for their education.

In addition, the officers of the Field Telegraph parks who are drawn from the Sapper battalions, as well as the soldiers taken as telegraphists and artificers, are attached to the State telegraph, so as to instruct them in all branches of the Telegraph service, and they are distributed to such stations as are not too far from the various Field Telegraph parks and are connected with them by a railway.

This sending-on-detachment is always carried out by the Inspector-General of Engineers in concert with the Telegraph Department of the Ministry of the Interior.

In peace the Field Telegraph parks take part in the yearly camp instruction with a third of their *matériel* and of their *personnel*.

9.—The Field Engineer Parks.

With each Sapper brigade is a Field Engineer park. The Field Engineer parks are distinguished according to the number and name of the brigade, as 1, 2, 3, 4, and Caucasian Field park. Each field park consists of three divisions, each division of four sections.

Normal Strength of a Field Park.

Fighting Strength.

	In War	In Peace
Park Commandant (Colonel or Lieutenant-Colonel)	1	1
Adjutant (Subaltern)	1	1
Captains	3	1
Lieutenants	3	1
Sub-Lieutenants	3	1
Ensigns	3	1
Sergeant-Major	1	1
Quartermaster-Sergeant	1	1
Section Under-Officers	3	1
Junior ,,	12	2
Corporals	18	6
Privates	90	31
Total	139	48

Non-Combatants.

Engineer Officials	3	1
Clerks	4	2
Hospital Sergeants	3	1
Farrier Sergeants	3	—
Master Carpenters	3	1
Master Smiths	3	—
Collar Makers	3	1
Train Under-Officers	3	3
,, Privates	66	3
Officers' Servants	18	7
Total	109	19

For Transport.

	Horses	
	In War	In Peace
Intendance Train :—		
3 4-horse Provision Waggons	12	—
1 4 horse Cash and Office Waggon	4	—
	16	

	Horses	
	In War	In Peace
Brought over	16	—
Engineer Train :—		
54 4-horse Park Waggons	216	60
Reserve Horses	24	2
Total, 58 vehicles with	256	62

As Riding Horses.

Officers' Chargers	12	—
Men's „	12	—
Total	24	—

The number of officers' baggage and men's mess waggons in war time is not determined.

The Field Engineer parks carry with them their movable reserve stock of entrenching tools and other instruments, which are necessary for the further strengthening of positions, as well as for the completion of works; the tools of Engineer or other troops become useless in the field.

On each of the 12 sections falls the necessary tools for a division of the Army and a Sapper company, which are calculated as follows for a Field Engineer park :—

(*a*) Tools for the Army.

7,200 Helved steel shovels
1,200 „ light hatchets
576 „ heavy „
960 „ cramps (Krampen)
960 „ picks
180 „ cramps and picks combined (Krampen mit Hauen)
144 Jumpers (Brechstangen)
144 Pinching bars (Gaisfüsse)
48 Fascine chokers
48 „ knives
24 Tracing lines, 21·3 m. long
24 Ordinary } keys for railway.
24 Vice }

(*b*) For the Sappers.

1. *Measuring Instruments.*

6 Surveyors' tables } with all apparatus.
6 Levelling instruments }

2. *Entrenching Tools.*

120 Heavy axes
24 Fascine chokers
24 „ knives
44 Augers at $1\frac{1}{4}''$, $1''$, $\frac{1}{2}''$
24 Tracing lines, with tools necessary for tradesmen and miners.

The entrenching and other tools are loaded on 48, the electrical apparatus and mining materials on 6 waggons.

The whole *matériel* laid down for the Field Engineer parks is kept in readiness at the brigade head-quarters in depôts of their own.

10.—The Engineer Siege Parks.

At present there are two Engineer Siege parks, which are numbered 1 and 2. Each park consists of four divisions, which in both parks bear the consecutive numbers 1 to 8.

Each division has a quantity of tools and Engineer *matériel* sufficient for the siege of an ordinary fortress.

Besides the *matériel*, the train necessary for its transport, which consists of 24 park waggons and 4 field forges, must be kept ready in peace.

The strength up to the present of an Engineer Siege park in war and peace is shown in the table.

From these the staffs for the Sapper brigades are told off, which remain at their station during war to superintend, as follows :—

1 Chief of Brigade (Major-General or Lieut.-General)
1 Chief of Brigade Staff (General Staff officer)
2 Senior Adjutants (Engineer officers)
1 Veterinary Surgeon
6 Clerks
1 Train private
8 Officers' Servants.

Total 20

As Train 1 cash and office waggon with 2 Train horses, 5 officers' horses.

In addition to the above Engineer forces and establishments, with their *matériel*, there are—

1. The Engineer arsenal at Dunebrg with 5 Staff and superior officers, 3 officials, 1 under-officer, 4 clerks, 8 officers' servants, 21

men for the production of the Engineer tools and other implements required by civil and military workmen, and necessary for the Field and Engineer troops and establishment. At the arsenals, besides, are held in readiness the complete component parts of the Train for a Sapper and a Pontoon battalion. Further, the reserve of bridging materials.

2. A central depôt of Engineer *matériel* at Bobruisk for the completion of the whole Engineer apparatus in war time.

3. Military district Engineer *matériel* depôts at Petersburg, Duneborg, Brest-Litewski, Kief, Moscow, and Tiflis, for keeping up the Engineer tools with the Engineers and troops in the field.

4. Fortress Engineer *matériel* depôts at Warsaw, Novogeorgievsk, Ivangorod, and Brest-Litewski, for the storing of the entrenching tools necessary for siege purposes.

As a general rule there should be ready in the above-mentioned Engineer *matériel* depôts—

83,163	Steel shovels
139,783	Hatchets
18,863	Cramps (Krampen)
21,144	Picks (Hauen)
2,007	Cramps and picks combined (Krampen mit Hauen)
322	15-lb. pinching bars (Gaisfüsse)
6,306	10-lb. „ „ „

Submarine Mining Companies.

The War Ministry order of May 11, 1877, No. 188, directed the formation of two Submarine Mining Companies, of which No. 1 is quartered at Cronstadt, and No. 2 at Kerc (Kertsch). They are intended for submarine mining service in the harbours either of the Baltic or the Black Sea, according to circumstances, and are under their own staff officers of the Engineer Corps, on whom falls the direction of the submarine mining service in the above-mentioned waters. These staff officers are directly under the head Engineer administration of the War Ministry.

The new formation is carried out by the transfer, provisionally, of officers and men from the Grenadier and Line Sapper battalions and the Pontoon battalions, for each company of two years' normal strength, as follows:—

	In War	In Peace
Company Commandant (Captain or 1st Lieut.-Col.)	1	1
Captain, 2nd Class	2	2
Lieutenants	2	2
Sergeant-Major	1	1
Quartermaster-Sergeant	1	1
Section Under-Officers	8	6
Junior „	16	12
Drummers	3	2
Corporals	40	20
Privates	210	180
Total	284	227
With Firearms	256	—
Non-combatants	32	31

Engineer tools carried by each Submarine Mining Company, 104 shovels, 12 hatchets, 10 cramps, 20 picks, &c.

The clothing, arming, and equipment of the Submarine Mining Company is the same as in the Sappers.

J. G. B.

RESERV

Total	Surgeons	ES			Of the Fighting Strength are armed	CARRIAGES					
		ught									
		Officers' Baggage	Men's Mess	Total	With Rifles	1-Horse	2-Horse	3-Horse	4-Horse	6-Horse	Total
4	...										
1,094	2	...	...	7	...	...	1	...	...	...	1
1,038	2	11	8	130	952	8	4	1	22	...	35
*1,030	2	11	8	130	952	8	4	1	22	...	35
256	...	11	8	130	952	8	4	1	22	...	35
251	...	2	2	20	238	2	1	...	4	...	7
1,014	2	2	2	20	234	2	1	...	4	...	7
1,014	2	...	8	12	936	8	...	...	...	...	8
532	1	11	8	99	904	8	4	1	16	...	29
169	...	11	4	454	352	5	4	1	7	58	75
247	...	...	1	1	152	1	...	...	...	...	1
293	...	...	2	2	...	2	...	...	...	...	2
139	...	7	1	208	...	1	2	1	12	21	37
227	...	...	...	280	...	...	...	...	58	...	58
285	...	...	...	399	...	...	...	112	4	...	116
		...	2	2	256	...	1	...	...	...	1
39,180	56										

Number and Normal Strength of the several Divisions	To form Companies	FIGHTING STRENGTH																				NON-COMBATANTS											
		Officers								Men												Officers				Men							
			Staff							Under-Officers					Drummers		Trumpeters									Under-Officers							
		Generals	Chief of Staff	Commandants	Junior ditto	Company Commandants	Subalterns	Adjutants	Administration	Sergeant-Majors	Quartermaster-Sergeants	Section	Junior	Volunteers	Battalion	Company	Battalion	Company	Musicians	Corporals	Privates	Total	Surgeons	Veterinary Surgeons	Other Officers	Bandmaster	Sergeant-Majors	Quartermaster-Sergeants	Clerks	Hospital Sergeants	Farrier Sergeants	Hospital Orderlies	Tr
IN WAR:—																																	
5 Sapper Brigades—Staff	...	1	1	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...	1	...	...	...	...	6	...	...	...	...
1 Guard Sapper Battalion	4	1	...	...	1	4	14	1	3	4	4	16	56	16	1	8	1	8	56	80	820	1,094	2	...	1	1	...	2	7	6	1	5	3
1 Grenadier Sapper Battalion	4	...	...	1	1	4	14	1	3	4	4	16	56	16	1	8	1	8	...	80	820	1,038	2	...	1	...	...	2	7	6	1	5	3
13 Line Sapper Battalions	4	...	...	1	1	4	14	1	3	4	4	16	56	16	1	8	1	...	*	80	820	*1,030	2	...	1	...	...	2	7	6	1	5	3
1 Turkestan Sapper Company	1	...	...	1	...	1	3	...	...	1	1	4	14	4	...	2	...	...	...	20	205	256	...	...	1	...	...	...	1	1	...	1	...
20 Reserve Sapper Companies	1	...	...	...	...	1	3	...	...	1	1	4	14	...	...	2	...	...	...	16	209	251	...	...	...	...	...	...	1	1	...	...	...
5 Ersatz Sapper Battalions	4	...	...	1	1	4	15	1	2	4	4	16	56	...	1	8	1	...	...	64	836	1,014	2	...	1	...	...	2	7	6	...	5	...
4 Railway Battalions	4	...	...	1	1	4	15	1	2	4	4	16	56	...	1	8	1	...	...	80	820	1,014	2	...	1	...	...	2	7	6	1	5	3
8 Pontoon Battalions	2	...	...	1	...	2	6	1	2	2	2	12	40	8	1	4	1	...	...	48	402	532	1	1	1	...	...	2	5	4	2	4	1
1 Caucasian Pontoon Company	1	...	...	...	...	1	4	1	...	1	1	4	8	4	...	2	...	...	...	16	127	169	...	...	...	...	...	1	4	2	1	2	...
1 Electrical Instruction Company	1	...	...	...	...	1	3	...	...	1	1	6	12	...	...	3	...	...	...	20	200	247	...	...	...	...	...	...	3	2	...	...	...
9 Field Telegraph Parks	...	...	...	1	...	3	3	1	...	1	...	30	36	...	...	...	...	...	...	36	182	293	...	...	...	...	...	...	4	1	2	...	6
5 Field Engineer Parks	...	...	...	1	...	3	9	1	...	1	1	3	12	...	...	...	...	...	...	18	90	139	...	...	3	...	...	...	4	3	3	...	3
2 Siege Engineer Parks	...	...	...	1	...	1	4	1	...	1	...	7	8	...	...	4	...	...	...	60	140	227	...	...	4	...	...	...	5	5	1	...	4
2 Submarine Mining Companies	1	...	...	1	...	1	4	...	...	1	1	8	16	...	...	3	...	...	...	40	210	285	...	...	...	...	...	...	5	1	...	...	...
Total Strength of Engineer Troops and Field Establishments	137	6	5	50	24	181	551	59	79	153	142	889	2,410	312	32	285	32	16	264	3,214	30,476	39,180	56	13	56	1	...	65	342	237	71	155	142
IN PEACE:—																																	
5 Sapper Brigades—Staff	...	1	1	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...	1	...	...	...	...	6	...	...	...	...
1 Guard Sapper Battalion	5	1	...	...	1	5	17	1	3	5	5	20	40	20	1	10	1	10	56	80	520	796	2	...	1	1	...	2	8	12	...	6	1
1 Grenadier Sapper Battalion	5	...	...	1	1	5	17	1	3	5	5	20	40	20	1	10	1	10	...	80	520	740	2	...	1	...	...	2	8	12	...	6	1
13 Line Sapper Battalions	5	...	...	1	†1	†5	17	1	3	5	5	20	40	20	1	10	1	...	*	80	520	*†730	2	...	1	...	...	2	8	12	...	6	1
1 Turkestan Sapper Company	1	...	...	1	...	1	3	...	...	1	1	4	14	4	...	2	...	...	...	20	205	256	...	...	1	...	...	...	1	1	...	1	...
7 Railway Battalion	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
8 Pontoon Battalions	2	...	...	1	...	2	6	1	2	2	2	8	32	8	1	4	1	...	...	32	218	320	1	...	1	...	...	2	5	6	...	2	1
1 Caucasian Pontoon Company	1	...	...	...	...	1	4	1	...	1	1	4	8	4	...	2	...	...	...	16	127	169	...	...	...	...	...	1	4	2	1	2	...
1 Electrical Instruction Company	1	...	...	...	...	1	3	...	...	1	1	6	12	...	...	3	...	...	...	20	200	247	...	...	...	...	...	...	3	2	...	...	...
9 Field Telegraph Parks	...	...	...	1	...	3	2	1	...	1	...	18	13	...	...	...	...	...	...	3	32	74	...	...	...	...	...	...	1	...	...	...	1
5 Field Engineer Parks	...	...	...	1	...	1	3	1	...	1	1	1	2	...	...	...	...	...	...	6	31	48	...	...	1	...	...	...	2	1	...	...	3
2 Siege Engineer Parks	...	...	...	1	...	1	1	1	...	1	...	2	2	...	...	1	...	...	...	20	40	70	...	...	1	...	...	...	2	2	...	...	2
2 Submarine Mining Companies	1	...	...	1	...	1	4	...	...	1	1	6	12	...	...	2	...	...	...	20	180	228	...	...	...	...	...	...	4	1	...	...	...
Total Strength of Engineer Troops and Field Establishments	96	6	5	41	20	140	356	50	61	112	101	561	1,045	372	23	195	23	20	264	1,649	10,959	16,003	38	5	31	1	...	47	229	244	1	109	51

* Hitherto in the 2nd, 5th, 8th Line and 1st Caucasian Sapper Battalions the brigade Band of 52 men.
† „ „ 1st, 2nd, 4th, 7th „ 3rd „ „ „ for the Ersatz Battalion 1 Lieutenant-Colonel and 2 Captains, with 4 Officers' servants and 1 riding horse.
‡ The soldiers uecessary to bring the peace to the war strength are borne on the general furlough and reserve lists. The augmentatiou supply of clothing, equipment, and arms, besides the barr

USSIAN ACTIVE, RESERVE, AND ERSATZ ENGINEER FORCES AND FIELD ESTABLISHMENTS.

Company	Musicians	Corporals	Privates	Total	NON-COMBATANTS: Officers: Surgeons	Veterinary Surgeons	Other Officers	Bandmaster	Men: Under-Officers: Sergeant-Majors	Quartermaster-Sergeants	Clerks	Hospital Sergeants	Farrier Sergeants	Hospital Orderlies	Train: Under-Officers	Train: Men	Other Professionals	Officers' Servants	Total	TOGETHER: Men	Horses: Riding: Officers	Riding: Men (Troop)	Draught: Artillery (Heavy)	Draught: Intendance (Light)	Draught: Officers' Baggage	Draught: Men's Mess	Horses: Total	Of the Fighting Strength are armed: With Rifles	Carriages: 1-Horse	2-Horse	3-Horse	4-Horse	6-Horse	Total
..	...	...	...	4	...	1	...	...	...	...	6	...	...	...	...	1	...	8	16	20	5	...	...	2	...	...	7	...	...	1	...	...	...	1
8	56	80	820	1,994	2	...	1	1	...	2	7	6	1	5	3	27	11	31	97	1,191	10	5	36	60	11	8	130	952	8	4	1	22	...	35
8	...	80	820	1,038	2	...	1	...	...	2	7	6	1	5	3	27	11	30	95	1,133	10	5	36	60	11	8	130	952	8	4	1	22	...	35
..	*	80	820	*1,030	2	...	1	...	...	2	7	6	1	5	3	27	11	30	95	*1,125	10	5	36	60	11	8	130	952	8	4	1	22	...	35
..	...	20	205	256	...	...	1	...	...	...	1	1	...	1	...	4	6	6	20	276	...	...	8	8	2	2	20	238	2	1	...	4	...	7
..	...	16	209	251	...	...	...	...	...	...	1	1	...	...	...	4	...	4	10	261	...	...	8	8	2	2	20	234	2	1	...	4	...	7
..	...	64	836	1,014	2	...	1	...	...	2	7	6	...	5	...	8	10	30	71	1,085	3	1	...	...	...	8	12	936	8	...	...	...	...	8
..	...	80	820	1,014	2	...	1	...	...	2	7	6	1	5	3	18	7	30	82	1,096	10	1	29	40	11	8	99	904	8	4	1	16	...	29
..	...	48	402	532	1	1	1	...	...	2	5	4	2	4	1	9	25	16	71	603	12	14	372	31	11	4	454	352	5	4	1	7	58	75
..	...	16	127	169	...	...	...	...	...	1	4	2	1	2	...	1	10	6	27	196	...	...	...	...	...	1	1	152	1	...	...	...	...	1
..	...	20	200	247	...	...	...	...	...	...	3	2	...	...	...	2	18	4	29	276	...	...	...	...	...	2	2	...	2	...	...	...	...	2
..	...	36	182	293	...	...	...	...	...	...	4	1	2	...	6	60	...	9	82	375	8	6	174	12	7	1	208	...	1	2	1	12	21	37
..	...	18	90	139	...	...	3	...	...	...	4	3	3	...	3	66	9	18	109	248	12	12	240	16	...	...	280	...	...	...	...	58	...	58
..	...	60	140	227	...	...	4	...	...	...	5	5	1	...	4	...	26	12	57	284	12	...	370	17	...	...	399	...	...	...	112	4	...	116
..	...	40	210	285	...	...	...	...	...	...	5	1	...	...	...	1	17	8	32	317	...	...	...	...	...	2	2	256	...	1	...	...	...	1
16	264	3,214	30,476	39,180	56	13	56	1	...	65	342	237	71	155	142	1,553	608	1,196	4,495	43,675	491	310	7,306	1,708	402	282	10,499	30,974	286	154	260	940	653	2,293
...	...	...	...	4	...	1	...	...	...	...	6	...	...	...	...	1	...	8	16	20	5	...	...	2	...	...	7	...	...	1	...	...	...	1
10	56	80	520	796	2	...	1	1	...	2	8	12	...	6	1	10	11	35	89	885	3	1	...	15	...	10	29	640	10	...	5	...	...	15
10	...	80	520	740	2	...	1	...	...	2	8	12	...	6	1	10	11	34	87	827	3	1	...	15	...	10	29	640	10	...	5	...	...	15
...	*	80	520	*†730	2	...	1	...	...	2	8	12	...	6	1	10	11	†34	†87	*†817	†3	1	...	15	...	10	†29	640	10	...	5	...	...	15
...	...	20	205	256	...	...	1	...	...	...	1	1	...	1	...	4	6	6	20	276	...	...	8	8	2	2	20	238	2	1	...	4	...	7
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	32	218	320	1	...	1	...	...	2	5	6	...	2	1	3	16	15	52	372	2	1	8	6	...	4	21	288	4	...	2	...	...	6
...	...	16	127	169	...	...	...	...	...	1	4	2	1	2	...	1	10	6	27	196	...	...	...	...	...	1	1	152	1	...	...	...	...	1
...	...	20	200	247	...	...	...	...	...	...	3	2	...	...	...	2	18	4	29	276	...	...	...	...	...	2	2	...	2	...	...	...	...	2
...	...	3	32	74	...	...	...	...	...	...	1	...	...	...	1	1	...	8	11	85	...	...	8	...	...	1	9	...	1	...	...	...	...	1
...	...	6	31	48	...	...	1	...	...	...	2	1	...	...	3	3	2	7	19	67	...	...	62	...	...	...	62	...	...	...	...	15	...	15
...	...	20	40	70	...	...	1	...	...	...	2	2	...	...	2	...	6	6	19	89	...	...	...	4	...	...	4	...	...	2	...	...	...	2
...	...	20	180	228	...	...	...	...	...	...	4	1	...	...	...	1	17	8	31	259	...	...	...	...	...	2	2	206	...	1	...	...	...	1
20	264	1,649	10,959	16,003	38	5	31	1	...	47	229	244	1	109	51	212	383	842	2,193	‡18,196	†91	23	454	299	2	200	1,069	12,706	196	12	91	79	...	378

rade Band of 52 men.
Ersatz Battalion 1 Lieutenant-Colonel and 2 Captains, with 4 Officers' servants and 1 riding horse.
general furlough and reserve lists. The augmentation supply of clothing, equipment, and arms, besides the harness and all the carriages, are stored at the stations of the various divisions.

ON ENTRENCHMENTS.

By Major-General Bainbrigge, R.E.

With extracts from a Translation by him of Lieut.-General Von Hanneken's 'Remarks on the Russo-Turkish War.'

The long defence of Plevna by the Turks, under Osman Pasha, against a large army, has brought more prominently before all nations the question as to whether their own troops are duly instructed and equipped for the defence and attack of field works; therefore it seems necessary, without delay, to consider the circumstances under which it may be required to construct them, and the means of doing this *rapidly*: for, as the writer stated in Vol. XI. *Professional Papers*, p. 241, 'It seems desirable to provide the means of having an engineer equipment *always with the advance*, sufficient to give every four men of the Line a pickaxe and shovel whenever it may be desirable to set them to work to improve their cover, and therefore to organise detachments of the Engineer Train with horses or mules provided with pack saddles, so as to convey the tools at a trot along roads filled with carriages which not even a cart could pass, and so that they could as easily retire if threatened with capture. They would enable troops not only, by means of *an hour's labour, to gain time*, which is always of much importance, but also to exhibit *unexpectedly* to an enemy entrenchments the strength of which he cannot test without incurring great loss.'

The great importance of the power of *rapidly* entrenching positions, thus urged sixteen years ago, is now acknowledged, and some recommend giving every soldier a pick or shovel to carry; but surely the rapidity of *marching* is of such vital importance that it is not desirable to add thus to the weight to be carried by men on foot, though mounted infantry or 'dragoons' may sometimes carry them with advantage—besides, they are likely to be thrown away, especially during a retreat; and therefore the most practical plan seems to be to make the Engineer officers responsible that tools, carried by horses or mules, in their charge, and thus capable of being taken where there are no roads, are ready to be distributed wherever they can be used with advantage; it seems useless to encumber the *regimental* carriages

with a full supply of tools, as this can only be required at certain positions, usually far in advance of them, for entrenching or for an attack, and although it would tend much to the rapid execution of entrenchments if the officers of infantry knew how to direct their men properly in such duty, it must not be forgotten that, as a very small error in fixing the positions of those works might lead to the fire from them being ineffectual, specially instructed officers must be made responsible for the tracing and general arrangements. This would also secure the possibility of adding to their strength by means of obstacles, flanking works, &c., if a few hours' delay is gained before they are attacked, so that eventually, as at Plevna, mere field works may become capable of prolonged defence, and be quite secure from assault.

As regards the tools required for an *attack* of field works, the fire of even badly disciplined troops has become so rapid and effective that there is no chance of passing or destroying obstacles, especially if under flank fire, without the most carefully prepared means, and the most thoroughly drilled troops, who can be relied upon to cut down palisades &c. at the proper places, and to prevent a check occurring in the advance under a murderous fire.

Sir John Burgoyne has given us some practical advice in Vol. XVIII. *Professional Papers*, p. 93, relative to the construction of hasty entrenchments, and it may be observed that the quickest way of forming a parapet is by digging a shallow trench close in rear of its intended crest line, and another three paces in front of it, so as to allow space for enlarging the parapet till it is about four feet high, if there is time; but if the ground is swampy or rain is likely, only the trench in front of it should be dug.

The remarkable defence of the Arab Tabia, in front of Silistria, in 1854, under the direction at first of Majors Nasmyth and Butler, and latterly of Colonel (now Sir Lintorn) Simmons (as described in Vol. VI. *Professional Papers*, p. 167), is a striking instance of the results of persevering work with the pickaxe, and of the political effects of a determined resistance by a small number of Turks without breech-loaders.

To show the views of experienced Prussian officers on this subject, the following extracts have been made from an article in the 'Militär-Wochenblatt,' for January 1878, written by Lieut.-General Von Hanneken:—

'The science of war especially requires us to base our conclusions upon the actual experience of war. Each war must therefore be studied critically, and if we notice anything new, its advantages must

be acknowledged, so that we may employ it to our own advantage, or, if the enemy tries to make use of it, that we may be able to meet it successfully.

'The war between Russia and Turkey shows us, although accurate accounts of it * are not yet available, that it is remarkable for the use of a factor in warfare which, though hitherto known, has acquired a new importance, and is likely to influence the general character of all future warfare.

'If we consider the progress of the war, and pass over the faults committed on both sides which the experience of former wars has led us to expect, as well as the events of the war in Asia, since we know as yet little more than the results of this, we notice a revolution caused by the appearance of Osman Pasha at Plevna, the effects of which are still apparent.

'When the news of the passage of the Danube reached Constantinople it was perceived that a crisis was at hand, and steps were taken to offer a real resistance. The whole Mahometan population were called to arms, and they obeyed this call with the greatest alacrity; but, though their numbers were great, time was required to send them to the front and organise them, and this could only be effected by means of the troops already there.

'A new leader was named for the chief army, by whose energy it was prepared to take the field. The army which was employed against Montenegro was recalled, and one half of it was brought by sea to the vicinity of Adrianople, whilst the other half was brought direct to the seat of war, by Sophia, where all the available troops were collected; and the commander of the Widdin army, Osman Pasha, received orders to advance against the Russians with all the troops which could be spared from thence, which were to be united with those collected at Sophia, including the half of the army which had come from Montenegro.

'In obedience to this order, Osman Pasha left Widdin with nearly 30,000 men, reached the road from Sophia to Sistova, secured his communications with Sophia, and reached Plevna shortly after the fall of Nicopolis, which he was unable to prevent.

'The appearance of such a strong force in the west was quite unexpected by the Russians, and they were generally blamed for not having sooner obtained information about it. In judging them, however, we must not forget that nearly the whole of the Russian cavalry were employed either in observing the Turkish main army eastward on

* This paper was written in October 1877.—Ed.

the River Lom, or were operating southward under Gourko over the Balkans, so that very few were disposable for scouting in the west. But little foresight was shown; nearly the whole of the Russian army was still within a space only 68 miles long and 45 miles wide, so that a sufficient force might have been concentrated in two or three days; and, however threatening and unexpected the appearance of Osman Pasha was, no great delay in carrying on the war would have occurred if he could have been attacked in the field.

'The first collision of the Russians and Turks near Plevna was in the open field. The Commander of the Russian army-corps near Nicopolis must have received very imperfect accounts of the strength of Osman Pasha's army, for, instead of attacking it at once with his whole force, he contented himself with sending only three regiments of infantry against it. At that time Osman Pasha had with him only the troops which had come from Widdin; his army was thus not much stronger than a Russian army-corps, and the first result of their attack, the obstinacy of the fight, and the failure, which was caused only by Osman bringing his enormous superiority of force to bear upon the assailants, rendered it probable that if the whole of the Russian corps had been sent against him he could scarcely have maintained his position at Plevna.

'A second attack was made upon Plevna, in which an apparently sufficient force of nearly 50,000 men was employed. Osman Pasha had also an equal number, having been strengthened by a corps from Sophia, but he would not trust to this increase of numbers only, for he had prudently entrenched himself and obtained for his position all the strength which can be gained by means of field fortification. * * * This second battle of Plevna, however, was, still more decisively than the first, to the disadvantage of the Russians. * * *

'It must be admitted that it would have been possible at that period to collect more troops in front of Plevna, perhaps 65,000 men; but, even if the attacking troops had such an enormous superiority in the assault of the fortified position of Plevna, scarcely any better result could have been expected, for a position well fortified with field works, if defended by a sufficient number of infantry armed with weapons capable of maintaining an accurate fire at a long range, *is now safe against any direct attack by open force.*

* * * * * *

'If at the second battle of Plevna the Russians did not follow all the rules which military science had hitherto laid down for the attack of fortified positions, at the third battle these were all carefully attended to. A more than sufficient army of 85,000 men was employed in the

attack, to resist which Osman Pasha had only 60,000 at the most. It commenced with a terrific fire from 300 guns of the newest construction, remarkable for their range and accuracy, and this fire was continued until the guns in the front line of forts were silenced; then strong swarms of riflemen advanced, and after these had established themselves at a distance of 300 paces from the works, so as to be within effective range, very strong columns pushed on to the assault. But even this well-arranged attack failed almost completely in spite of the extraordinary bravery of the troops, who did not retire until one half of the assaulting columns had fallen.

'The Turks failed in the same way in the assault of the fortified position in the Chipka Pass, and the leader of the main Turkish army, notwithstanding its temporary superiority of numbers, dared not attack the fortified positions held by the Russian army of the Jantra eastward of Biela, but contented himself with taking up a position on the River Lom for observation, the result of which was, that as soon as the Russians, by the addition of large reinforcements, obtained a superiority of numbers he was obliged to withdraw to the fortified position at Rasgrad.

* * * * * *

'The opinion has already been stated that a position *well protected* by field works, and occupied by a *sufficient force* of infantry armed with weapons capable of maintaining a rapid fire at a long range, is safe against a *direct* assault by open force; but what then is meant by the words *well protected*, *sufficient force*, and *direct assault*?

'Reliance for security against assault cannot be placed upon obstacles such as the profile of the field works, but depends upon the power of bringing to bear upon the assailants, at the greatest range of modern arms, a fire from infantry placed under good cover. Therefore there must be everywhere in front of the works a space 2,000 paces wide open to the fire of infantry at the extreme range of their weapons; the thickness of the parapets must be sufficient to protect the defenders against the enemy's artillery fire, and the works must be so placed that each may support the adjacent ones with their infantry fire. If the fortified position fulfils these conditions it may be called *good*. Such a position may be considered fully occupied when there is a sufficient reserve, besides the proper garrisons of the forts, to bring up to the points threatened with an assault a number of fresh troops as great as that of the assailants.

'Lastly, by the words "direct attack" is meant one made from the front of the defences: therefore it implies that no part should be exposed to an attack from all sides. This does not mean that an

enclosed fort may not be attacked on any side of it: it only means that the works must not be so extended that the attack against one side becomes an attack against the flank or rear of another side, but continues to be really a front attack.

'If a fortified position fulfils all these conditions, it may be considered safe from assault. The events of the Russo-Turkish war have verified this, though theory also points to the same conclusion.

'The final aim of every assault is the hand-to-hand struggle to obtain a decisive success; but this is preceded by a succession of attacks of various kinds, the object of which is to diminish as much as possible the number of troops who would be ready to take part in this decisive final struggle. Modern artillery fire has rendered these preparatory attacks so powerful that in most cases the defenders do not wait for the concluding struggle, but most of them retire and thus declare themselves beaten, although they have not been really defeated.

* * * * * *

'It is clear that the defenders of a fortified position, being covered by the parapets, will not suffer very seriously from the preliminary fire, whilst the assailants, who have to traverse a zone nearly 1,800 paces wide exposed to fire, which takes 10 minutes, will during that time be exposed to 30 or 40 shots from each of the defenders. Certainly most of these, at first on account of the great distance, and latterly on account of the hurry with which they are discharged, would miss their aim; but the more disciplined and courageous the troops are, the greater number of hits they will make, and, if the garrison is not very small and the attacking columns are not unusually strong, the loss of the latter will almost always be so great that they will be driven back before they can engage in a hand-to-hand fight, even when they are composed of courageous troops in good heart.

'"What is required then to render fortified positions secure from assault, and how can they be attacked with success?"

* * * * * *

'The War of Secession in America affords the only experience from which we can deduce rules for the attack and defence of fortified positions. Help in learning the art of war may be derived from its protracted attacks and oft-repeated attempts; and General Lee, on one side, has, in the construction and defence of fortified positions, as well as General Sherman, on the other, in the attack, by his obstinate and decisive battles at Atlanta, afforded very good lessons.

'Struggles like those which they carried on will constantly occur in future wars, and it is necessary to become as thoroughly acquainted with the peculiarities of battles in entrenched positions, and to prepare

troops to engage in them as efficiently, as has hitherto been the case with regard to battles in the open field.

'As before explained, the security of fortified positions against assault greatly depends upon the effect of modern firearms, and especially of those of the infantry. If the defenders cannot see, and if, consequently, their fire does not hit, whilst they can only deliver a few shots before the assailant's storming columns come to close quarters, security against assault cannot be obtained, and they have only the advantage afforded by obstacles which in field works are generally easy to overcome.

'In the night, and during fogs, they can see little or nothing, and in both cases modern firearms are not more effective than the old ones, so that the arrangements will continue the same as formerly. The assailant must in both cases find a road which he cannot see, and must commence fighting before he knows the ground, or can obtain any knowledge as to the progress of other columns and their being ready to support his attack, whilst the defenders are upon ground well known to them, and feel sure of due support and connection.

'These were the causes which prevented great battles being fought at night; and isolated cases, like the affair at Hoch Kirch, show plainly that they can only occur under very peculiar circumstances.

'Considering the undeniable superiority which modern firearms give to the defence, it may, however, be asked, whether by choosing the place and time an equality may not be restored to the attack, and whether night attacks, in spite of their disadvantages to the assailants, may not be employed by them more commonly, provided that circumstances are favourable to them. Among such circumstances may be reckoned the occurrence of an attack upon ground which is well known to most, if not to all, the leaders of the attacking troops. If to this is added a knowledge of the distribution of the defenders, a night attack would be less disadvantageous to the assailants than an attack by day, and would therefore be preferred. This knowledge, both of the ground and the enemy's dispositions, is, however, nearly impossible to be obtained by the assailant of a fortified position. By fortification the ground is materially altered; and the works themselves, if they are not very badly laid out, cover the position of an army in and behind them, so that a general attack during the night or in a fog is among the most desperate means of conquering the enemy which an assailant could grasp at. It is quite different, however, when the object is only to get possession of a single point close at hand; the line of retreat, visible by day, can then be observed so exactly, that it can be easily found by night or in a fog; the body of troops required

is only small, and can advance in one, or at most two, columns, and at least the exterior form of the works at that point is known. For such a partial attack, therefore, a night assault is advantageous; and the only difficulty, besides the fight itself, is the maintenance of the position when won, for the defender, also taking advantage of the night or the fog, will return the assault, to resist which the assailants must have reserves ready, the strength of which it is hard to fix beforehand, and the application of which on unknown ground is a special difficulty for the assailants, which the defender, being perfectly acquainted with it, does not feel.

'Just as the security of works against assault does not exist during a time when one cannot see, so it is when one cannot fire. This may occur if for some reason the greater part of the defenders have made a sally; for if the assailants succeed in beating them back, and can follow them so closely as to arrive simultaneously in front of the works, a general assault may be made with effect; and the Russo-Turkish war affords us, in the taking of the Turkish works at Lowatz, a splendid example of this for our imitation.

'These attacks made at night, or in pursuit of beaten troops, demand attention to rules generally useful, and, being derived from a combination of those for regular sieges and for battles in the open field, are especially applicable to operations against field works.

'Such operations involve a formal siege, for the assailant has not only to destroy their security against assault by all the means which he has available, but there must also be a battle, since there are two armies facing each other; and at every encounter the principles to guide their movements must be taken from the general tactics. Even when first opposed to each other the two adversaries feel the importance of this double relation.

'Whether the assailant only observes the enemy's works, or proceeds to attack them if he is strong enough, he must bring his army near enough to be able to support with his whole force at any moment the portion of his troops intended for the actual assault; for, if not, the latter will be attacked in force and overpowered by the defender if he has troops enough. He can scarcely place his army in front of the works without some cover, otherwise they would be liable to be attacked by the defenders, and would be worn out by being kept always on the alert, whereas the defender need only keep the garrisons of his forts, which could be changed daily, in readiness for defence, whilst the main body of his troops can repose in safety. Therefore the assailant must entrench himself, and yet his troops must be so close to the enemy as to ensure quick support of those in front.

The distance between his works and those of the defender will depend upon the ground; but, at any rate, will be at most equal to the ordinary effective range of field pieces, and therefore not more than 3,500 paces.

'The next problem which the assailant has to solve is how to form covered approaches leading towards the enemy's works, which must be advanced until the open space to be traversed during the assault is reduced to the utmost. His attacking columns will then be exposed to the fire of the defenders for a short time only; therefore he will not suffer great loss and has reason to expect success, for the security from assault of the enemy's works will no longer exist. The defender has thus two problems to solve: not only must he so strengthen the works against which the enemy's attack is directed by every means afforded by field fortification, from simple palisading to fougasses, as to re-establish their security against assault by adding obstacles, but he must endeavour to hinder the assailant from employing hidden obstacles, and make use of all the means which the presence of a whole army gives for preventing the weakness usually inherent in the garrisons of fortresses.

'The assailant will construct extensive, broad, and deep parallels, provided with numerous communications towards the rear, adapted to afford covered positions for large bodies of troops, and which must be so arranged as to form actual advanced forts. Parallels like those in front of a fortress, which are meant rather for cover than for security against sorties, would prove insufficient to resist an attack by the enemy's army. In order to advance rapidly, posts adapted for the purpose will be seized, preferably at night, and fortified, and parallels will be run out from them and from the communications, so that trenches may be pushed forward until they are close to the enemy's works. But this cannot be effected without obstinate fighting: direct counter attacks will probably check the work, but will not entirely stop it, yet the defenders can also employ saps in order to reach positions from whence they can enfilade the newly constructed approaches. Every such attempt of the defenders requires fresh arrangements on the part of the assailants, and thus the space between the works constructed by the two armies becomes a field of battle, in which they both exhaust their strength by constant fighting. If the fortified position is deep enough the struggle must begin again, after the loss of the front line of works, with the defence of those lying in rear, and this sort of fighting need not cease until the forces on one side or the other are quite exhausted. But then other conditions will arise, as during a formal siege, for it may happen that the

defence is so splendid that the besieger renounces any further attack, though he gives up the investments in general only in consequence of operations independent of those connected with the siege. In such attacks against works, just as in other attacks, the defender may be beaten as well as the assailant, and he who first exhausts all his strength must give up his works and retire, for the space between them gets so completely covered with works on both sides that not only can the assailant advance under cover to the defender's works, but the latter also can do the same ; whichever, therefore, has not strength to continue to fight will be beaten as thoroughly, or perhaps even more completely, than under the worst conditions of a battle in the open field. Attacks against fortified positions are not terminated in the short space of one day, but require repeated daily efforts which last for weeks and sometimes even for months. Time enough is afforded to expose every error in management, to carry out every design which military genius can conceive, and to make use of every advantage which the discipline and valour of armies give. He who is beaten in an attack against works will probably be beaten in other warlike operations, and an army beaten in such an attack will not be fit for a fresh battle, either in the open field or among field works, without being reorganised. But the time which is required to assemble and organise these fresh troops, if they can be got, may perhaps be obtained by the beaten army, and so we may conclude that wars will, in consequence of these repeated combats among entrenchments, not end until the forces of one of the powers engaged in them are exhausted by the other.

* * * * * *

'We may often wish to fight in entrenchments when, after losing a battle in the open field, we have the opportunity of retiring to a fortified position in our rear, and thereby may not only stop a victorious enemy, but gain time enough to attempt to retake what has been lost. And thus we arrive at the question, "Is our army instructed in the attack and defence of field works, and is it duly equipped for it ? "

'We may easily be armed for this kind of warfare, but we must first have the tools necessary for taking possession of a position rapidly. Pickaxes and shovels are the weapons which are especially needed, in addition to other weapons, for this purpose, and certainly in far greater quantities than our army has hitherto possessed, even in any branch of it ; and even if a sufficient number were carried with the trains, this would not suffice : the troops must have them close at hand, and we must not wait until they are required to collect and distribute them,

since for this alone more time would probably be necessary than could be spared in time of need.

'Our army is but little exercised in the war of field works, although this branch is not entirely neglected; indeed it is carried on by us with greater care than by most of the European armies.

'Let us consider the circumstances under which it is necessary, or even only desirable, for an army to fortify its position. We find ourselves suddenly in front of a more powerful enemy, or we have been beaten, and must either stand firm in a fortified position or give up to the enemy a great extent of the "Fatherland."

'In both cases we shall have but little time to construct fortifications which fulfil the requirements above detailed: in the first, a judicious commander desires to avoid the enemy's attack for twenty-four hours; in the second, an obstinately fighting rear-guard wishes to stop the foe who follows them for at least as long a time. Will twenty-four hours suffice, with the existing organisation of the army, to form such a fortified position? We certainly have generals enough who, with a rapid military glance, could in a few minutes construct in their minds such a position, but before their ideas could be executed a longer time than a short day will be required.

'There is indeed in our army a sufficient number of officers, even in the infantry, who are able to throw up a large fort without the aid of officers of Engineers educated in this branch of military science, but they could scarcely get it finished in one day, for the troops have not the skill in work which is so necessary. It would certainly be possible for our Engineer troops to do this, but what could a couple of battalions of Engineers effect towards fortifying a position for a whole army immediately? We shall not have advanced far enough in this branch of military labours until each regiment of infantry is equipped and exercised so as to be able to construct a large work in twenty-four hours at most, without technical assistance. This is a new branch of duty for our infantry, but it is not so prodigious as it seems to be at first sight.

'For such fortifications it is only necessary to afford cover for the defenders against the direct fire of artillery, which requires only that they should have high and strong parapets, and that they should be placed so as to command the ground in front with infantry fire, whilst the latter may also easily act obliquely towards both sides. Hence it follows that in their construction all refinements may be avoided as far as concerns either their trace or profile, and it is sufficient when the order is given, "to build at a certain place a work for commanding a certain space," to obey it by forming a sufficiently long and thick parapet

with flanks somewhat turned backwards. The systematic arrangements can easily be made for this purpose, and are confined to the due division of labour beforehand, so that in this branch of duty, as in others, the execution of the work may directly follow the issuing of the order for it.

'The completion of the works, as, for instance, strengthening the parapets with fascines to enable men to fire over them conveniently, may follow later if the nature of the soil requires it, and this may be left for the Engineers. The work itself is so simple that it does not require very much practice to fit men to execute it, and if it was carried on once a year by each Division in order to show the soldiers how to execute what they learn theoretically, our troops would be duly prepared to undertake anything in this branch of their duty which can be expected of them.'

There seems as yet but little trustworthy information available as to the details of the works at Plevna and Lovtcha, but the following extracts from the 'Times' correspondence of March 20, 1878, will be useful, as being written by an eye-witness of the effect of the artillery and musketry fire on both sides:—

'There is one other subject in connection with modern breech-loaders which has been suggested by my experience in watching the campaign in Bulgaria, and this is the uselessness of artillery fire directed upon earthworks held by tenacious infantry armed with breechloading rifles. Nikopol was bombarded for twenty-one days by numerous pieces of artillery, some of them six inches in calibre, located on the Roumanian shore of the Danube; some of the batteries were within 1,100 yards of the Turkish parapets. I examined the Moslem earthworks on the day Nikopol fell, and they were in perfect condition, and yet I had seen shot after shot strike the parapets of the Turkish redoubts and batteries. The small amount of damage caused during the daytime was fully repaired at night. At Lovtcha I saw fifty pieces of artillery concentrate their fire on the great redoubt for two and a half hours, and not a Turk left his place behind the parapets, or in the outlying infantry trenches; the guns had been removed from the redoubt, and there was no Turkish artillery fire to distract in any way the aim of the Russian artilleryman. The Russian practice was good, the earthen walls were struck in all directions. I saw the shell holes after the work was captured, but no effect was produced upon the garrison, and I found only one dead man, who had evidently been killed by a shell. The inevitable conclusion is that the Russian shells fired at

Nikopol and Lovtcha were simply wasted, and when the original cost of the guns, ammunition, &c., is taken into account the sum total of useless expenditure is something enormous. Artillery fire is manifestly of no avail unless it frightens the enemy from his positions, or kills a sufficient number to make the effect somewhat proportionate to the cost of the ammunition and equipment. If it does neither the money expended is wasted.

'Plevna furnishes a still more striking evidence of the facts above stated. More than 500 guns, a large number being 6-inch siege pieces, hurled ton after ton of iron upon the Turkish lines from the 7th of September to the 10th of December, and, as mentioned in my telegraphic account of the fall of Plevna, the Moslem fortifications were entirely uninjured when I rode over them on the day after Osman Pasha's surrender. The Turkish artillery seldom responded, and therefore the Russians had the bombardment all their own way. They had the ranges as accurately determined as human skill could do it, and yet the effect was practically a nullity—not one yard of the Turkish trenches was ever cleared by shell fire. When the Turks fired from their guns the effect was equally a *minus* quantity; and after watching the operations around Plevna for two months, and carefully inspecting the Turkish fortifications after the surrender, the conclusion was absolutely forced upon me that every rouble expended by the Russian artillery had been wasted, and that the capture of Osman Pasha's army had not been hastened one hour by the myriads of shells hurled at its lines of defence. I am well aware that such ideas are startling, but I have conversed on this subject with other observers of the siege of Plevna, and have never heard a dissentient opinion regarding the inutility of the Russian artillery during the operations ending in the capture of the army of Osman Pasha.

* * * * * *

'That the Turkish soldier does not take an accurate aim is evident from various circumstances which have come under my personal observation. In the first place, he is invisible when the Russians are advancing upon his entrenchments. I have often heard the Muscovites complain that they could not see even the heads of their enemies, while at the same time the bullets were coming in clouds; and although very few take effect in comparison with the myriads fired, yet still the number of men hit, coupled with the invisibility of the Moslems, has a very depressing effect upon an attacking force. It is evident that a man cannot fire over a breastwork and take aim at anything outside of it without exposing the whole of his head to an enemy's view; therefore, the concealment of the Turkish heads and the

great proportion of hand wounds among the Turkish prisoners show conclusively that the Moslems crouch behind their entrenchments and raise their rifles above their heads when in the act of firing. The superior slopes of their earthworks are generally shaped so as to range in a plane about a yard above the surface of the glacis, and therefore they can lay their rifles upon the breastwork, and, pouring in the cartridges by dozens, keep up a terrible fusillade with very little danger to themselves. I have watched Russian assaults when a perfect sheet of fire was streaming from the Turkish trenches, and yet I could not see a single head above the parapets. But this method of firing is a very poor one so far as efficiency is concerned, especially when the ground is broken in front and the enemy can secure cover at times during his advance. At the capture of Lovtcha I saw the Turks fire continuously for from five to ten minutes at a time, when there was not a Russian in sight, as the assaulting lines had stopped under shelter to recover their breath for another dash forward. The Turks were hidden behind their earthworks, and in all probability did not know that the enemy had halted out of the reach of their bullets. Again, when the assault was made on the great redoubt at Lovtcha, the Russians were compelled to charge up a steep hill-side, where there was no cover for 200 yards in front of the Turkish ditches. A perfect hail of bullets was poured over the Moslem ramparts, and the garrison never left their banquettes until the Russians mounted the parapets; yet when I rode up this glacis after the capture of the redoubt there were not twenty men lying dead upon that open space. These were all shot in the head or neck, showing that the great mass of the bullets had passed over the heads of the assailants. Had one-half the usual proportion of shots taken effect, that glacis would have been covered with dead bodies and the attack repulsed.'

The plan of the works at Plevna is copied from that published in the 'Times' of December 13, 1877, and the description of them is from the same:—

'The figures upon each hill and ridge denote the elevations in feet above the River Vid. Commencing at the Vid, north of Plevna, we find the height of Opanes rising 600 feet above the river, and crowned with the Turkish redoubts Nos. 1, 2, and 3 (I have numbered the Moslem redoubts in figures; there are many Russian redoubts, but for reasons already mentioned I have not given their locality). North-east of this height is Bukova Ridge, rising to an elevation

equal to that of Opanes, and separated from it by a slight depression; east of Bukova Ridge is the now celebrated ridge of Gravitza, separated from the former by a deep valley, in which is the village of Bukova, and on the slope the redoubt No. 4, defending the valley. The crest of the Gravitza Ridge is so flat that a redoubt placed upon the top of it could not command the slopes on either side; therefore the Turks built a work on each edge of the crest to sweep both flanks of the hill. No. 5 is the redoubt which the Roumanians have sapped up to and unsuccessfully assaulted; and No. 6 is the widely-known Gravitza Redoubt, taken by assault by the Allied forces on the sanguinary 11th of September. Nos. 5 and 6 are about 600 feet apart; west of the last two redoubts is V, the entrenched camp crowning the western end of the ridge. This brings us to the valley of the Gravitza river, in which lies the village of the same name; the Plevna-Biela Chaussée comes down the southern slope of the Gravitza Ridge, and enters the valley at the village. South-east of the village is Krüdener Hill, where General Krüdener had his head-quarters when the last attack upon Plevna commenced; on the western slope was a battery containing eight of Colonel Exton's 6-inch guns from Slobosia, long since advanced nearer to Plevna. To the west is Exton Hill, and on the south-eastern end was the other battery of Exton's, containing twelve more of his 6-inch brass pieces. This battery was intended to be placed on the north-western end of the height, but in the darkness of the night of the 6th of September was fixed by mistake at the opposite extremity of the hill. South of Exton Hill is the Radichevo Ridge, crowned by Russian batteries, and in the valley at the foot of the southern slope is the village of Radichevo and the source of the little rivulet bearing the same name. To the west is Imeretinsky Hill, crested by heavy earthworks, the nearest point to Osman Ridge, bristling with redoubts Nos. 7, 8, 9, 10, 11, 12, and 13, defending the approach to Plevna by the Biela Chaussée, the only practicable road on the eastern side of the Moslem stronghold. Around this cluster of redoubts raged a fierce conflict during the September assaults, when the Russians tried in vain to drive out the Turks. Some of these redoubts have been battered level with the earth by the plunging fire of the Russian artillery, but they are still held by the Turkish soldiers, who have burrowed in the ditches around these works, and are ready at a moment's notice to shower a hail of bullets upon an attacking force. South of Osman Ridge and Imeretinsky Hill is the wide-sweeping elevation which I have christened Todleben Hill; it extends on the south and west to the Tutchenitza ravine, which is bounded on both sides by perpendicular walls of limestone rock, with only one crossing

place between the village of Tutchenitza (near its source) and Plevna. It is rather singular that in a locality so rough and hilly as that around Plevna the stratification of the rock should be perfectly horizontal, showing that the valleys and ravines are the probable work of erosive action during many thousands of years. These strata are perfectly regular, about one foot in thickness, easily separated, and the stone, being closely similar in texture and hardness to white marble, would make splendid building material. The soil of Bulgaria is the finest for brickmaking I have ever seen, and yet the inhabitants live in mud hovels half dug in the earth.

'Skobeleff's Ridge crosses the Lovatz road at a point about six kilometres from Plevna, and was the first line occupied by that General at the commencement of the regular siege; he then advanced to the line of the Brestovatz Hill, and the elevation marked C on the map. This line was occupied without any serious opposition on the part of the Turks. Skobeleff's next move was to carry the height marked B known as the Mamelon Vert, or Green Mountain, the details of which I telegraphed from here at the time it occurred. From this vantage point he has gradually advanced his lines to the positions shown at the foot of the Krishine Ridge. Redoubts Nos. 14 and 15 are connected by a covered way; these are the two works captured by Skobeleff on the 11th of September, and from which he was driven after holding them with his shattered battalions for twenty-four hours, during which time he vainly called for reinforcements. It will readily be seen that had he been properly supported Plevna would in all probability have fallen, as he had pierced the centre of the Turkish line. The affair of the 11th of September was justly characterised in my presence by a Russian General as "an attack by 20 battalions and a demonstration by 80, instead of being, as it should have been, a demonstration by 20 and an attack by 80 battalions." Redoubt No. 16 has been constructed since Skobeleff's attack. No. 17 is the well-known Krishine Redoubt. It is very large, has a high "command," and is a work apparently impregnable to an assault. Nos. 18, 19, and 20 defend the southern front of the Krishine Ridge, and Nos. 21, 22, and 23 the western ends of the Krishine and Moslem Ridges, while open batteries protect the bridge over the Vid on the Sofia road.

'All these Turkish redoubts are connected by infantry trenches, and the interiors are so filled up with bomb-proofs and traverses that artillery fire has no practicable effect upon them. The constructors have simply left open spaces enough for gun platforms and the passage of the infantry and artillerymen to their places behind the parapets. On the hills D E G are the Russian lines south of the Krishine Ridge;

they are separated from the latter by slight depressions and the hill F, which is not in the possession of either party. When I visited the trenches on hill G, commanded by General Mirkovich, of the Volnyhie Regiment of the Imperial Guard, he informed me that there had been no firing in his front for six days; the Turks were strolling about in front of and upon their entrenchments at a distance of 800 yards, and some of the Guard were on hill F after wood. The hills D E G were occupied without any fighting, the Turks falling back to their present line when Gourko cut the Sofia road by the capture of Telis and Gorny Dubnik. The Turkish front on the Vid from Tyrnen to the Sofia road is so steep as to be practically unassailable, and the valley of the Brestovatz creek would have formed their best defence on the south, as the southern slopes of the hills bounding this creek on the north are steep and difficult to ascend at the rapid pace required for an assault on earthworks defended by breechloaders. The only reason that can be given for the abandonment of the line D E G is the want of sufficient troops to guard the requisite length of line to include these heights. The western side of the Vid is a rich alluvial valley about two kilometres in width, and from the western edge of this valley rise the gentle slopes of Gourko's Ridge, upon which are placed the allied entrenchments. The valley is closed at each end by heavy trenches, and the only place affording an easy exit from Plevna (by going down the right bank of the Vid and crossing above Susurlu and making for Widdin) has been blocked by damming the Vid so as to overflow the crossing-place and render it impassable for infantry.'

P. J. B.

tion [illegible], on October 12th, of Gorny Dubnik (High Oak-wood) on the Sophia road, the regular investment of the fortified camp at Plevna commenced; the communications of Osman Pasha were finally inter-

PLEVNA
Etropol
Gourkos Ridge
100
VALLEY OF THE VID
River Vid
Opanes Ridge
Opanes
600
Bukova
Bukova Ridge
600
PLATEAU
550
Gravitza Ridge
To Biela
Gravitza
Gravitza River
From Sofia
Olengas
Bluzivas
PLEVNA
Krudener's Hill
Radichevo
Radichevo Ridge
Moslem Ridge
500
Tyrnen
600
Krishine Ridge
Plevna Ridge
Todleben Hill
480
Tuchenitza Ridge
520
Krishine
Kirtozab
Brestovatz Hill
480
Brestovatz
Tuchenitza Ravine
Kirtozab Hill
Skobeleff's Ridge
500
Bogot Ridge
Ghinetha River
To Lovtza
Bogot
Obchendol
Russian Lines.
Scale of Yards.
0 1000 2000 3000 4000 5000
Turkish Fortifications.

THE

INVESTMENT OF THE FORTIFIED POSITION OF PLEVNA AND SURRENDER OF THE TURKISH ARMY, NOVEMBER 28TH, 1877.

Report to His Imperial Highness, the Commander-in-Chief of the Field Army, by Adjutant-General Todleben, of December 28th, 1877.

TRANSLATED FROM THE RUSSIAN BY CAPTAIN G. T. PLUNKETT, R.E.

(*N.B.—The dates in this paper are Old Style.*)

The army of Osman Pasha occupied at Plevna a fortified camp, very strong in its defensive capabilities, and presenting several lines of formidable positions, which the enemy in the course of our prolonged sojourn near Plevna—dating from the end of July—considerably strengthened, profiting by all the advantages of the locality, and applying his fortifications to it very successfully. The resistance offered by these fortifications was further increased to a very great extent by the unprecedentedly heavy fire from breech-loading muskets, while immense stores of cartridges permitted the enemy to scathe with an unceasing leaden hail the space in front of the fortifications for a distance of two versts. Besides this, owing to the extent and depth of the enemy's positions, he could keep his reserves out of fire of our artillery; moreover, all the ravines and defiles converged towards the town itself, thus enabling the reserve, from its central position, in the event of an attack on our part, to relieve in ample time any one of the fronts threatened. These conditions, in the highest degree disadvantageous for us, explain the chief causes of the failure of our attempts of August 30th and 31st to storm the Plevna fortifications, and the decision then taken, in order to avoid bloodshed, of renouncing any new attempt on Plevna by open force, and, pending the arrival of reinforcements, to enter upon the regular investment of the Turkish army.

On the arrival at Plevna of the Guard Corps, and upon the occupation by them, on October 12th, of Gorny Dubnik (High Oak-wood) on the Sophia road, the regular investment of the fortified camp at Plevna commenced; the communications of Osman Pasha were finally inter-

rupted; and from that time his army was reduced to one of two alternatives: either to force its way through the lines of investment or to lay down its arms after using up all the provision stores.

On this question of supplies depended the power of the Turkish army to prolong its stay in Plevna after the investment was completed. To determine precisely the quantity of provisions at the disposal of Osman Pasha was difficult; but, after taking everything into consideration, it was impossible to conclude that the provisioning of the Turkish army at Plevna was secure for a period of more than about two months.

Once having decided to take Plevna and capture the Turkish army defending it by the process of investment, it only remained to carry out unflinchingly this line of action, entirely renouncing every attempt to storm which might not lead to a decisive result, and might only needlessly increase our losses; at the same time, to draw as close as possible the line of investment, taking every precaution for preventing the enemy anywhere breaking through the lines of our forces. In furtherance of this object, our efforts were directed towards the strengthening of all the positions of the investing army by lodgments, trenches, batteries, and, at the more important points, by lunettes and redoubts, the concentration of artillery fire against the enemy's fortifications, and the gradual pushing forward of trenches and lodgments to such a distance from those of the enemy as to draw off as far as possible his musketry fire from our batteries. Further, it was necessary to undertake the construction between the positions of convenient roads, and the erection upon them of guide posts and signals to facilitate the movements of the army, the building of bridges, and the establishment of telegraphic communication round the whole line of investment; finally, all measures were taken to meet a possible sortie of the enemy by the largest available force ready to ward off an attack at any point he might select. To this end the positions round Plevna, extending along a line of investment of seventy versts, were divided into six sections, for the defence of each of which a force was allotted corresponding to its extent and relative importance. At the same time all the commanders of these sections weighed the possibilities of a sortie and laid their plans accordingly. Moreover, some days before the army of Osman Pasha came out into the open, I executed a manœuvre in the sections entrusted to Generals Ganetsky and Kataly, in order to calculate with accuracy the time necessary for concentrating the forces in case of a decided attack by the invested army. This was the position of affairs on the eve of November 28th. From reports received at the Headquarters Staff from all the sections of the investment line during

November 27th, as well as from the testimony of deserters, it was evident that Osman Pasha was preparing to bring his army out into the open in order to break through the investing lines. On November 26th the enemy's artillery fire had already sensibly slackened; on the 27th it entirely ceased. Deserters gave information that supplies of biscuits and shoes had been distributed to the soldiers, and that their arms had been examined and repaired. On the Sophia road, near the town, there were observed great movements and concentration of considerable forces and trains in the Turkish camp; whilst on the river Wid the Turks began constructing a bridge under cover of the fire of the Oponetsky works. All these preparations showed that the enemy was preparing to break out and that the sortie would, in all probability, be directed against the section of General Ganetsky.

With this in view, after laying a preliminary report of all the circumstances of the case before the Commander-in-Chief, His Highness the Prince of Roumania, and with his approval, I issued the following orders on the evening of November 27th.

(1) One brigade of the 16th Infantry Division, with three batteries, and a brigade of the 3rd Division of Infantry of the Guard, under the general command of Lieut.-General Skobeleff, to cross on November 28th, at daybreak, to the left bank of the Wid, and take up position as follows: the brigade of the 16th Infantry Division, with three batteries, near Dolny Dubnik, and to be ready to support the force under General Ganetsky; the brigade of the 3rd Division of Infantry of the Guard to remain behind the two redoubts nearest to the river Wid, on its left bank, and to be ready to support, as circumstances might require, the corps of General Ganetsky or that under General Kataly.

(2) The other brigade of the 16th Infantry Division, with three batteries, to remain on their own ground in complete readiness for marching.

(3) Three battalions of the 3rd Tirailleur Brigade, comprised in the army of the 4th Section, to move early in the morning of November 28th to the village of Grivitsa, in order to reinforce the army of the 2nd Section entrusted to Lieut.-General Baron Krudener.

(4) The advanced position on the Plevna-Lovcha road, from Redoubt Mirkovich to the Tuchenitska ravine, to be occupied by a brigade of the 30th Infantry Division; its other brigade to remain in camp behind Rijy Gora (red hill) in full readiness for marching. The command of the troops of the 4th Section to be entrusted to General Shnitnikoff.

(5) To direct four battalions of Roumanians, with three batteries, on November 28th, at daybreak, from Verbitsa on Demirkioy; and

four more Roumanian battalions, with two batteries, in Verbitsa itself, to be ready for marching. This disposition of the forces, whilst supporting the corps of Lieut.-General Ganetsky, rendered it possible to strengthen the forces of the other sections of the investment in case of an attack of the Turks in another direction with the object of drawing off our attention from the real point of the sortie.

On the night between November 27th and 28th, a deserter reported to the commander of the Plevna-Lovcha corps that the Krishinsky Redoubt was evacuated by the Turks.

General Skobeleff immediately gave orders to send forward a party of volunteers to ascertain the truth of this information. The volunteers found the redoubt abandoned by the enemy, and consequently, towards morning on November 28th, the greater and lesser Krishinsky redoubts, as well as the trenches on the Zelena Gora (green hill) were occupied by the 30th Infantry Division.

At the same time that information was received of the occupation of the Krishinsky redoubts by our troops reports were made to me, about nine o'clock in the morning, of the abandonment of the Turkish redoubt No. 10, and of the occupation of the redoubt in front of Grivitsa by the Roumanian army. Seeing this, I ordered all the troops on the right bank of the river Wid to advance. The brigades of the 16th Infantry Division, with three batteries, and also the 9th, 10th, and 11th Tirailleur Battalions, who had not yet had time to reach the village of Grivitsa, were directed to keep along the left bank of the river Wid, and also hold themselves at the disposal of Lieut.-General Skobeleff, supporting General Ganetsky.

At mid-day, His Majesty the Emperor was pleased to arrive in the Imperial Redoubt, between the village of Radishewo and the Tuchenitsky ravine, where His Majesty was pleased to observe the advance of our army on the eastern side and the cannonade on the left bank of the Wid.

At early dawn fighting began between the army of Osman Pasha and the troops of General Ganetsky. In the night of November 27th–28th, the outlying pickets at the position occupied by the Grenadiers were composed, in the 2nd Grenadier Division, of the 5th Grenadier Kieff Regiment, and, in the 3rd Grenadier Division, of the 9th Siberian Regiment of Grenadiers.

This force occupied all the lodgments of the line of defence. Their nearest supports were the second regiments of the brigades, that is, the 6th Taurus Grenadiers and the 10th Grenadiers of Little Russia. All the 9-pounder guns of both Artillery Brigades were distributed among the earthwork batteries of the lines of defence, whilst the

4-pounder batteries with the 2nd brigades of their divisions, constituting the Reserve, were stationed near Gorny Netropol and Dolny Dubnik.

The lodgments and lunettes to the north of Gorny Netropol and the village itself were occupied by the 17th Archangel Regiment of the 1st Brigade, 5th Infantry Division, with two Roumanian batteries; the 18th Vologda Regiment, of this brigade, being posted in reserve with two batteries.

Before night the cavalry vedettes had reported the concentration of considerable Turkish forces on the River Wid ; but with the approach of morning, about half-past seven o'clock, the Turkish advance developed itself. As the line of our outposts fell back, Major-General Daniloff, attached to the suite of His Majesty, commanding the 3rd Grenadier Division, ordered the second battery 3rd Grenadier Artillery Brigade, occupying position Battery No. 3, to open fire, and the 10th Little Russian Grenadier Regiment to move to Kopano Mogilo (cemetery) ; at the same time the second brigade of the division, with the 4-pounder batteries, was called up from Gorny Netropol.

While these dispositions were being carried into effect it became light enough to see distinctly part of the forces opposed to us which had been concentrated during the night, and the train of vehicles of every kind accompanying them. The Turks opened fire from cannon placed on heights near the bridge and below it commanding the river Wid as they rapidly deployed their forces, taking advantage of the fog which had settled over the valley of the river, and covered by a long inequality in the ground in front of the bridge permitting large masses of troops, which had been collected on the left bank even before dawn, to conceal themselves behind it.

The enemy's advance directed against the lodgments of the 3rd Grenadier Division was effected with remarkable impetuosity ; a continuous chain of skirmishers came first, followed immediately by supports in loose formation ; behind these came the reserves. Artillery accompanied the chain of skirmishers and also advanced rapidly, halting only for one discharge and then overtaking the line.

Notwithstanding the repeated fire of our 9-pounder batteries and the fusillade of the Infantry occupying the lodgments, the Turks in three quarters of an hour's time crossed the space separating them from our position, and gained our line of defence occupied by the advanced parties of the 3rd Grenadier Division at Battery No. 3. The enemy having penetrated into the intervals between the entrenchments, and having destroyed by their fire almost all the defenders, encountered only feeble remnants, and these, not strong enough to resist any longer, began to retire.

When the trenches on the flank of the Field Work No. 3 were occupied by the enemy, and most of the artillerymen in Battery No. 2 cut down, the gunners had only succeeded in withdrawing two guns from the works and removing the breech bolts of the remaining six. About half-past eight A.M. the troops occupying the centre of the position—viz. the 2nd battalion and 2nd and 3rd skirmisher companies of the 9th Grenadier Siberian Regiment—disorganised by their heavy losses in men and officers, began to retire towards Kopano Mogilo (cemetery) and the left lunette. The 3rd battery of the 3rd Grenadier Artillery Brigade, occupying the entrenchment No. 4, held their ground for some time longer, firing grape, but, threatened by a flanking movement on their right, at length abandoned the position, carrying away with them only six guns, the horses of the remainder being killed.

While the Siberian Regiment was thus engaged with the enemy, the 10th Little Russia Grenadiers opportunely arrived and, formed in companies in two lines, moved up into the interval between lunette No. 4 and Kopano Mogilo. Receiving into its ranks the Siberians, the Little Russia Regiment stopped the advance of the enemy, experiencing in so doing considerable losses; in the space of a few minutes three battalion and half the company commanders were placed *hors de combat.*

The determined and desperate attack of the enemy became more and more serious for us.

The 1st brigade of the 3rd Grenadier Division was too enfeebled by its efforts to hold the lunettes ; 8 of our guns were in the hands of the enemy ; the 2nd brigade of the 3rd Grenadier Division had not yet arrived to the rescue.

About 10 A.M. the 2nd brigade of the 3rd division began to draw near the scene of action, and at the same time news was received that the 8th Moscow and 7th Samogitian Grenadier Regiments of the 2nd Grenadier Division were already approaching to support the position of the 3rd Grenadier Division. The arrival of these reinforcements ensured the successful issue of the fight to us, and finally deprived the enemy of the possibility of accomplishing his intended sortie. At 10.30 A.M. a loud 'Hurrah' apprized us of an attack by the 2nd brigade of the 3rd Grenadier Division on our lodgments occupied by the Turks. Driving the enemy out of both lunettes, the Astrachan and Phanogorian Regiments, supported by the Siberians and Little Russians, rapidly advanced, regardless of the losses inflicted on them by the infernal fire of the enemy, and drove the Turks out of the trenches with the bayonet. Our guns which had been left in the hands of the enemy were retaken, and in addition to this the Astrachans captured 7 Turkish guns and one

standard during the fight. Two battalions of the 18th Vologda Regiment, having moved out still earlier to the lunette on the left flank and adjoining lodgments of the Grenadier position, operated against the enemy in flank, in which they were supported by the fire of a Roumanian battery.

Simultaneously with the attack of the 2nd brigade of the 3rd Grenadier Division, at a quarter to eleven o'clock, the 7th Samogitian Grenadiers came into action, directed by Lieut.-General Svechin, commanding the 2nd Grenadier Division, in the interval between Gorny and Dolny Netropol. The 3rd battalion of this regiment found part of the lodgments of the 3rd Grenadier Division still occupied by the enemy. Charging with the bayonet, the Samogitians, without firing, drove the Turks out of the lodgments, and, having put to flight the remainder of the enemy's troops, captured 3 Turkish guns.

Having reoccupied the advanced lodgments, our forces halted for a time. It was about twelve o'clock in the day when the Turks began slowly to retire to the River Wid, keeping up, however, a vigorous fire. The guns taken from the enemy not having been rendered unserviceable were directed against the Turks and were served by the infantry.

At the same time all the batteries of the 3rd Grenadier Artillery Brigade were moved forward, and taking up a position in line with the infantry, poured grapeshot into the retiring Turks.

The retreat of the enemy became more disorganised and precipitate. Dense crowds of Turks in disorder thronged the bridge and mingled with the train which covered with a dense mass the ground near the road.

Seeing the complete rout of the Turkish forces and the enormous losses they had sustained, Osman Pasha could no longer think of renewing the sortie, more especially as our army had already assumed the offensive in other places.

Moreover, the expected arrival of the 16th Infantry Division, and the support given by an approaching brigade of the 3rd Infantry Division of the Guards, fully assured the final defeat of the enemy.

Very soon our forces took the offensive along the whole line. The division of General Daniloff moved forward, supported on the left towards Gorny Netropol by the 1st brigade of the 5th Infantry Division and on the right by the 2nd brigade of the 2nd Grenadier Division.

The 1st brigade of the 2nd Grenadier Division having come out of the lodgment began to envelope the left flank of the Turks. Besides this the 2nd battalion of the 5th Kieff Grenadiers and one battalion of the 6th Taurus Grenadier Regiment were directed to ford the river Wid and occupy the heights on the right bank of the river. The Grenadiers having crossed the Wid up to their belts in water, climbed

the Blazewatz heights and rushed into the enemy's redoubt, the garrison of which surrendered without firing a shot.

The brigades of the 3rd Guard and 16th Infantry Division, dispatched according to my order of November 27th to reinforce the detachment of General Ganetsky, did not take part in the battle. According to Lieut.-General Kataly's report he moved on November 28th, at seven in the morning, to the left bank of the Wid, by means of a pontoon bridge, 6 battalions of the regiment of the 3rd Infantry Division of the Guard, with two batteries, under the command of Major-General Kurloff. At ten o'clock in the morning this detachment, on the demand of General Ganetsky, set out for Dolny Dubnik, where it received an order from the commander of the Grenadier Corps to advance along the Sophia road and bear down upon the left flank of the enemy. While this movement was being executed Major-General Skobeleff arrived, and, having taken the command of the detachment, ordered General Kurloff to halt his force near them in columns of reserve, and await the arrival of the brigade of the 16th Infantry Division. After remaining stationary about two hours without having received any further orders from General Skobeleff, General Kurloff again led his men forward along the Sophia road, reaching the stone bridge across the Wid when the fight had already ceased.

At the time when the 2nd and 3rd Grenadier Divisions were heroically repulsing the attacks upon them of the whole Turkish army, the other detachments of the investing force under the command of Lieut.-General Zotoff, Baron Krudener, and Kataly—Major-General Shnitnikoff and General Chernata commanding the Roumanian Corps—moved towards the enemy's fortifications on the eastern and southern fronts. The greater part of these works were already evacuated by the Turks, and our troops, in the presence of your Imperial Highness, occupied the town of Plevna. Having occupied the town, the troops, by the personal command of your Imperial Highness, continued the advance to the river Wid, your Imperial Highness placing yourself at their head, in rear of the enemy, and gradually concentrated on the heights to the west of Plevna, near the Sophia road. The Roumanian forces, with his Highness Prince Charles, who was present with them all the time, on approaching the river Wid encountered opposition from the Opanetsky redoubts, which were still occupied by the enemy. After a short fight the garrisons of these fortifications laid down their arms, when the Roumanians captured 3 guns and 2,000 prisoners. General Kataly with parts of the 3rd Infantry Division of the Guard, who had remained on the right bank of the Wid, observing the retreat of the Turks towards the river, determined to take possession of the redoubts situated opposite the Wolinsk hill, in order to prevent the enemy from returning to his fortified camp.

At half-past eleven o'clock the Rijy ('red') redoubt was occupied without fighting, and after an insignificant resistance the redoubt Mohammed Tabia also surrendered. About one o'clock, after a brief fusillade, the Sacharnay Golovka ('sugarloaf') and Cherney ('black') redoubts were occupied, as well as another redoubt situated behind the last mentioned.

In the enemy's fortifications 1 Pasha, 120 staff and superior officers, 3,634 of inferior grades, and 4 guns, were captured by the Guards. The losses on our side comprised only 3 rank and file killed and 15 wounded.

The Turks, pressed on all sides by superior forces, could not prolong the fight; they sent out a parlementaire, and the chief of the staff of the Turkish Army rode out to meet General Ganetsky, and announced that Osman Pasha was wounded and desired to know the conditions of capitulation. General Ganetsky demanded the unconditional surrender of the whole army. On receiving Osman Pasha's consent, he personally set out to visit his brave and resolute wounded enemy.

On the memorable 28th November, there surrendered as prisoners of war, 10 Pashas, 128 staff officers, 2,000 superior officers, and 40,000 of inferior grades of the infantry and artillery, besides 1,200 cavalry. 77 guns and a quantity of warlike stores were captured, especially musket cartridges. The losses suffered by the enemy in the last fight amounted to 6,000 men.

On our side, in the 2nd and 3rd Grenadier Divisions the losses were as follows: killed—2 staff officers, 7 superior officers, and 409 of the lower ranks; wounded—1 general, 3 staff officers, 47 superior officers, and 1,263 of lower ranks.

In the 1st Brigade, 5th Infantry Division: wounded—1 superior officer and 47 others.

Thus the system of operations adopted at Plevna, consisting in a persevering adherence to a complete blockade without having recourse to the extremely hazardous and always sanguinary attempts to storm the Turkish fortifications, resulted in the attainment of the desired end. The result comprised the capture of 40,000 of the best of the enemy's troops, and the occupation of an important strategical point closing the principal roads into Western Bulgaria. In the meantime our forces were not only kept up during the investment, but their numbers were supplemented and reorganised with renewed strength and spirit, and were ready to undertake fresh feats for the glory of the Russian arms.

In conclusion, I deem it my duty to bring to the notice of your

Imperial Highness the services of Lieut.-General Prince Imeretinsky, commanding the staff, who was my invaluable assistant in this difficult affair crowned with the splendid successes of November 28th; to the late commanders of sections of the investment; to Lieut.-Generals Ganetsky (to whom, with the Grenadier Corps, belong the honour of the last days of the investment of Plevna), Zotoff, Baron Krudener, Kataly, and Skobeleff; to General Chernata, commanding the Roumanian corps; to Major-General Moller, directing the line of artillery engaged; to Major-General Reutlinger, acting as commanding engineer.

Having been a witness during two months of all the operations of the army before Plevna—of their firmness, valour, and self-denial in enduring difficulties and privations of every kind—it is with feelings of deep regard towards the troops that I can testify to your Imperial Highness that the behaviour of all ranks in the army which invested Plevna, from general to soldier, was beyond all praise.

(Signed) Adjutant-General TODLEBEN.

G. T. P.

NOTE.—Captain Plunkett has to thank Mr. E. Delmar Morgan for kindly looking over and correcting the manuscript, thus enabling him to produce what he trusts will be found an accurate translation of the original Russian.

THE THIRD BATTLE OF PLEVNA

AUGUST 26–31, O.S. (SEPTEMBER 7–12), 1877.

Extract from the 'Revue Militaire de l'Etranger,' Saturday, 2nd February 1878.

Translated by Captain G. T. Plunkett, R.E.

The stroke of strategy so happily dealt by Osman Pasha during the last days of July had stopped short and checked the first rush of the invading army. Recovering from its surprise, however, the Russian head-quarter staff would not withdraw the outspread fan formed by the army of the Danube in front of the point of crossing, and took the bold resolution of maintaining its positions by force over the whole of the country which had been invaded and *liberated* (?). Under such conditions they could hardly hope, at least for a time, to avail themselves of the advantages to be gained by acting on *interior lines*; they had to await the necessary reinforcements called for from their own country in order to resume active operations. The power of initiation therefore passed to the defenders, who in fact tried to profit by it; but their efforts, although energetic and sometimes crowned with partial success, were spread over too large a field, and they were not sufficiently combined and, above all, not sufficiently concentrated to bring about any decisive results.

To this period of offensive operations on the part of the Turks belong the following actions which we will enumerate here for the sake of convenience. On the Kara Lom (Black Lom), army of Mohammed Ali Pasha: Aiaslar, 22nd August; Kara Hassan Kioi (Black Hassan Hill), 30th August; Katselevo and Ablevo, 5th September. On the Balkans, army of Suleiman Pasha, assaults on the Hain Kioi and Shipka passes, 21st and 25th August. On the Osma, army of Osman Pasha, Pelichat and Sgalewitsa, 31st August. This interesting phase of the campaign, in which the two sides seemed to have exchanged *rôles*, lasted during the whole of August and the first few days of September. The Russian armies did not abandon their attitude of defence till the 3rd September,

and the affair of Lovcha was the prelude to the resumption of operations. This first vigorous blow showed clearly enough—what indeed there was hardly an attempt to conceal—the direction in which the principal attack would be made. As we have already said, the capture of Lovcha would, in the opinion of the head-quarter staff, prepare for and facilitate that of the intrenched camp at Plevna, which had become by a sort of fatality a question of pressing and vital importance. Without doubt, the Russian armies acting on interior lines could have chosen either direction, but it is easy to understand that the Commander-in-Chief would wish first of all, at any cost, to relieve himself from the troublesome and threatening proximity of Osman Pasha—a constant menace, which might perpetuate the state of paralysis which had once been brought upon their operations.

It was necessary, then, to take Plevna.

But after two repulses in succession it was clear enough that it would never do to risk yet another failure ; it was necessary to prepare with the greatest care this third attack on Plevna, to make sure of everything which could conduce to success, particularly of sufficient numbers, in which respect, as was said, their weakness principally lay in the two former assaults.

Whilst the troops to reinforce and complete the army were marching towards the theatre of war, valuable support was found on the spot; the Roumanian army, the active co-operation of which had just been assured, passed the Danube, and three of its divisions were intended to take part in the new operations against Plevna.

But if it was essentially necessary to make sure of the decisive blow which it was intended to strike against Osman Pasha, it was also requisite to take into account other but not less important considerations. The lines of communication were very long, the means of transport insufficient, and, should the principal army of operation continue inactive for even a short time longer, the weather might prevent the campaign being brought to a successful termination before the cold season. Also, the very natural wish to pass the crisis before the commencement of winter, and to avoid a second campaign, seems to have outweighed the considerations of prudence suggested to some extent by two serious and unlooked-for repulses.

However this may have been, the army of the West began to relinquish its defensive attitude before the arrival of the last reinforcements, and the commencement of active operations against Plevna was fixed for the 26th August (7th September).

'At this period,' says the *Invalide Russe*, 'the army of the West, under the orders of Prince Charles of Roumania, included the 4th and 9th corps (Krylow's and Krudener's), the 2nd division of infantry,

and the 3rd brigade of chasseurs, three Roumanian divisions, three divisions of cavalry, and three regiments of "Calarassi" (Roumanian irregular cavalry).'

We have no intention of reviewing the varied phases of this third battle of Plevna, which lasted six days. The most interesting episodes were around the 'Montagnes Vertes'; but before passing to these it will be well to take a glance at the general course of operations. We will gather this from the Russian documents.

'The fundamental principle of the attack was as follows (Report of Lieutenant-General Zotoff, chief of the staff of the army of the West):—Preparatory bombardments, as prolonged as possible, of the enemy's works, the intensity of which was to go on increasing in proportion as the artillery advanced; approaches for the infantry executed under cover of inequalities of the ground, and, finally, the attempt to storm.'

The *Invalide Russe*, which reproduces these same ideas, adds thereto another, the importance of which will be seen by all—'to direct the principal attack on the right flank of the enemy's position, to the south-west, towards the heights called "Montagnes Vertes."'

When the order, in a prearranged battle like this one, lays down the direction of the principal attack, it at the same time points out that all the other operations will be more or less *secondary*—more or less *demonstrations*; it indicates to some extent the general outline of the action. Criticism will subsequently have the opportunity of discussing the choice of the spot for decisive action, but when once this direction of the principal attack is admitted as a fact it gives a sure basis for following the distribution of the troops, the conduct of the engagement, the placing and employment of the reserves, and, in short, for a little study of tactics. If the *Invalide* did not, as has too often happened, arrange the plan of the battle *à posteriori*, one might evidently find a proof of its assertion in the official documents.

Strange to say, the orders of the 23rd August and of the 30th August (11th September), the day of the assault, show no trace of any prearrangement of this kind; the three assaults seem to be parts of the same plan and to be alike of the same importance; the general reserve follows, according to the order of the 30th, the central attack. But, on the other hand, the report dated 15th September of General Zotoff expresses in two places and in formal terms that the attack of the Montagnes Vertes is *the decisive attack*: first, 'On the side of the Lovcha road, where it was proposed to deal the decisive blow, &c.' and, second, some pages further on: 'The attack on the redoubt (one of the redoubts of the central system, opposite the plateau of Radichevo) was intended to facilitate the attack on the principal point, and particularly on the works

which defended Plevna on the side of the Lovcha road, and constituted, by their position, the strategic and tactical key of the entrenched camp.'

This is clear. Let us now resume our summary.

The troops of the army of the West were to leave their camps at six o'clock in the evening, on the 23rd August (6th September), and to take, in the night of the 25th and 26th, out of effective range of the enemy's artillery, the following positions:

'The IXth Corps d'Armée, commanded by General Baron Krudener (31st division and three regiments of the 5th division with their artillery), detaching to the main reserve one regiment and one battery of 4-pounders, to occupy the entire region between the Grivitsa Bulgarene road and the road which leads from Plevna to Pelichat.

'The IVth Corps d'Armée, under the command of General Kryloff (16th and 30th divisions, with their artillery), detaching to the main reserve one brigade with two 4-pounder batteries, on the left of the IXth Corps, to occupy the heights called "the Radishevo heights."

'The detachment of Prince Imeretinsky (2nd division and its artillery, three batteries of the 3rd brigade of chasseurs, and one battery of four guns—new 9-pounders) in rear of the left wing of the IVth Corps, near Tuchenitsa.

'The 4th Roumanian division, in conformity with the orders of Prince Charles, was to quit Verbitsa, take post to the north of the Grivitsa road above our IXth Corps, and thus to form the extreme right wing of the general front.

'Three regiments of *Calarassi* guarded the whole space between the right wing of the Roumanians and the Wid.

'The 8th Astrakhan and 9th Kazan regiments of dragoons, the 9th Bug Uhlans, the 9th Don Cossacks, with two horse batteries under the orders of General Lochkareff, were placed on the Grivitsa road to communicate with the IXth Roumanian Corps d'Armée.

'The 1st brigade of the 4th division of cavalry with one horse battery, under the orders of General Leontiff, was posted to the left of Radishevo to cover the left wing of the IVth Corps, and to communicate with the brigades of Cossacks of the Don and Caucasus, charged with watching the Plevna-Lovcha road.

'The general reserve, 2nd brigade of the 3rd division, 20th Galitsa regiment, three 4-pounder field batteries, the Marionpol and Kieff hussar regiments with a horse battery, was placed to the west of Pelichat, at the crossing of the Grivitsa-Tuchenitsa and Pelichat-Plevna roads.'

There are omitted from this enumeration of the forces of the Western Army two Roumanian divisions (the 3rd division and the

reserve division), which did not come to the support of the 4th till the 27th August (8th September).

In their advance towards the entrenched camp, the troops kept the order of battle indicated above, their front only was extended to the right and left. The detachment of Prince Imeretinsky, placed at first in rear of the IVth Corps, crossed the Tuchenitsa ravine and took up its post before the 'Montagnes Vertes,' above the troops intended for the central attack; the cavalry of General Lochkareff crossed the Wid to threaten the communication of Osman Pasha with Sophia.

'In the night of the 26th August,' says the *Invalide Russe*, 'our troops took up their position, unseen, at short artillery range from the Turkish entrenchments, and during the whole night, without being remarked by the enemy, excavated cover for siege and field guns, and at six o'clock in the morning of the 26th a converging fire was opened from these on points carefully observed and noted beforehand. The enemy replied with vigour, and his fire did not slacken the whole day. The next day two of the Roumanian divisions came to reinforce our right wing. Our artillery drew nearer to the works, the 4-pounders and the Roumanian artillery came into action; the cavalry on the right wing were ordered to cross the Wid and to act decisively against the enemy's communications; the detachment of General Prince Imeretinsky with General Skobeleff was ordered to take the lead and attack the "Montagnes Vertes," which command the town of Plevna.

'These orders were accurately carried out. At daybreak the troops of Prince Imeretinsky attacked the second ridge of the "Montagnes Vertes," drove the enemy away from it, and pursued him up to the third ridge, but were in their turn repulsed and obliged to retire to the second, which they held and quickly entrenched.

'On the 28th August, the Turks in their turn attacked with vigour the troops of General Skobeleff. Although these attacks, again and again repeated, were repulsed by the brave General Skobeleff and his men, they nevertheless proved that the enemy, cannonaded along the whole front and threatened on all sides, was still strong enough to attempt offensive measures. Consequently it was decided to continue for some days longer the bombardment, in order, as far as possible, to ruin the works and demoralise the defenders. But the weather changed heavy rains began to fall, the bad state of the roads caused anxiety as to the means of replacing the ammunition which was expended; and on the 29th August it was resolved to continue the bombardment during that day only, and to deliver the assault the next day.

'On the 30th August, according to the arrangements of Prince

Charles of Roumania, our troops attacked the enemy. The points chosen for attack were the following: The redoubt of Grivitsa, the works in the centre (opposite the heights of Radishevo), and the Third Crest of the "Montagnes Vertes." After superhuman efforts and enormous losses our troops carried the first and the last of these points. The Grivitsa redoubt (one of the redoubts) and two redoubts to the south of Plevna were in our possession; as to the central works, our troops, notwithstanding that they showed a bravery beyond all praise, could not carry them. Consequently, we had obtained during the 30th some partial successes; but fresh troops were necessary to profit by our gains, and these were not forthcoming. It was decided, therefore, to keep the Grivitsa redoubt, and to abandon the "Montagnes Vertes." Thus ended the six days' combat before Plevna' &c.

Having borrowed this general sketch from the *Invalide Russe*, we may now turn to one of the most important episodes of the battle, the affair of the 'Montagnes Vertes.' There are two reports which we will reproduce. In the first of these General Skobeleff addresses himself to his immediate superior, and explains the operations of the detachment up to the 30th only. From the 30th, the day of the assault, this General seems to have had more independence, and it is doubtless on this account that on this occasion he addresses his second report to the Commander-in-Chief.

Report of Lieutenant-General Skobeleff to Lieutenant-General Imeretinsky, dated 3rd (15th) September.

'In conformity with the orders of the Commandant of the Western army, dated 23rd August, the troops entrusted to your Highness were, after the capture of Lovcha, directed on Plevna, in order to take part in the operations against the entrenched camp at that place.

'On our arrival at the village of Bogot, 24th August, the following troops of the detachment entrusted to me rejoined their corps: Regiment of Kagan (64th), 1st battalion of Schonia (1-18th), and the 2nd battery of the 16th brigade of artillery.

'After having directed towards Bogot the brigade of Caucasian Cossacks with some infantry and artillery, I advanced along the high road to Plevna with three sotnias of Cossacks and two guns, to make a personal reconnaissance of the southern part of the entrenched camp. This reconnaissance and those of the following days showed how important it was to make the attack on this side.

'By the order No. 5, dated 25th August, you entrusted to me the command of the first *echelon* of your corps d'armée, and this *echelon*

included the regiments of Kalonga and Esthonia, the 9th and 10th battalions of chasseurs, the 1st, 2nd, and 3rd batteries of the 2nd brigade of artillery, the 3rd battery of the 3rd brigade, one long-range battery ; Colonel Tchernozouboff's brigade; in all, 8 battalions, 36 guns, and 3 sotnias.

'On the 27th August, according to your Highness's orders, the first *echelon*, as well as the second, were directed from Bogot on Radishevo, where they formed a reserve on the left wing of the troops of the IVth Corps. On the 26th August, the corps d'armée of your Highness, with the first *echelon* leading, moved towards the Selvi Lovcha high road and established themselves in front of the wooded heights situate to the south of Plevna. The same day preparations were already made for the attack on these heights.

'The 3rd battalion of the Esthonia regiment occupied the village of Brestovets without fighting, and this covered the position of our batteries in rear of the village; the 1st and 2nd batteries of the 2nd brigade, and the long-range battery, took post in rear of epaulements selected and arranged beforehand, and opened fire on the Krishina redoubt as well as on the heights in front of them. When our troops appeared on the plateau in rear of Brestowets, the enemy commenced violent and well-directed cannonade. Captain Kouropatkina, with remarkable coolness, directed all the operations under fire. We began to lose men. After the preparatory fire by artillery, which was kept up till three in the afternoon, the Kalonga regiment received orders to attack and carry the Second Crest of the wooded heights called Montagnes Vertes. The forward movement was commenced by the 2nd and 3rd battalions of this regiment; the 1st battalion following the other two at a distance of half a verst (530 metres).

'The following formed a general reserve to the attacking columns: The 1st battalion of the Esthonia regiment, and four companies of the 2nd battalion of the same regiment (the Rifle company of this battalion assisted the 3rd battalion in the occupation of Brestowets). At ten minutes after four in the afternoon, Colonel Eljanovsky, commanding the Kalonga regiment, found that he was confronted by a line of the enemy, who opened fire at 500 paces, and he awaited further orders. The regiment received orders to stop, and I advanced to examine the situation. When I arrived on the Second Crest I no longer found there the 1st and 2nd battalions of Kalonga. These battalions, after losing their colonel, wounded, following a few leaders, and led on by the example of some of the men, had rushed on, attacked the Third Crest, strongly occupied by the enemy, had carried it, and, following the enemy, had seized the lodgments at the foot of

the heights. The enemy, recovering from their surprise at this sudden attack, brought up considerable forces of infantry and cavalry, attacked our left flank, and in their turn forced the Kalonga regiment to abandon the trenches and beat a retreat. At the same moment, and by my direct orders, the 3rd battalion of the Kalonga men, deploying in front of the Second Crest, covered the retreat, but, attacked in its turn, it was thrown back on the Second Crest, where it was able, thanks to the help of some companies of the Esthonia regiment, not only to hold its position but even to oblige the enemy to stop his pursuit. The 2nd sotnia of the Cossack regiment of Vladikavkaz, the 6th sotnia of the 26th Cossack regiment of the Don, and half the 3rd sotnia of the 21st Cossack regiment of the Don, under the command of the *starchina*, Baron Stakelberg, were very actively employed during this part of the action either in covering the retreat of the Kalonga regiment or, and especially, in carrying off the wounded from the field of battle.

'This day cost us no less than 900 men, 700 of whom belonged to the Kalonga regiment. In spite of these enormous losses the regiment was reformed after the battle by the officers of my staff on its first position, and the soldiers returned, singing, to the line of battle. This bloody repulse of the 5th infantry regiment is to be attributed partly to the early loss of its brave colonel, severely wounded, but chiefly to the thorough insufficiency of the reconnaissance which I had made before the attack on the Turkish positions, changed so much since the battle of the 12th July. In short, the reserves on the left wing of the attack were insufficient. This was the grand mistake. I took up a position on the Second Crest, I reinforced the two Esthonia battalions by two battalions of chasseurs, and under cover of these troops I had the wounded collected. The night passed quietly. At two in the morning I received notice that the attack on the town would be put off for a day. Taking into consideration this delay, I drew back the troops of the right wing a little and occupied on the First Crest, between the Plevna road and the Tuchenitsa ravine, another favourable position which could resist a sortie of the enemy; then, in spite of the fatigue of the troops, I made them fortify this position immediately. When this was done there were two lines of deep trenches, with an excellent field for their fire, formed in front of them by a kind of glacis. In this brisk action besides the Colonel Eljanovsky, Captain Kouropatkina, of the Staff, again rendered me invaluable services. I think it my duty here to pay a tribute to the memory of the painter Verechaguine, who met a soldier's death. The Esthonia regiment alone constituted the first line. At five in the

morning of the 28th of August the enemy in considerable strength threatened our centre between the village of Brestowets and the position to the east of the road occupied by two battalions of the Esthonia regiment. Overwhelmed by a musketry fire, and by the fire of the 1st, 2nd, and 3rd batteries of the 2nd artillery brigade, as well as by the long-range battery, the enemy's columns halted, deployed as skirmishers, and opened fire in their turn. The 5th battery of the 2nd brigade, which had advanced to within very short range, and in a few minutes lost a great part of its men and horses, was obliged to retire. Nevertheless the fire of the Esthonia regiments and of the artillery obliged the enemy to fall back towards half-past six o'clock. At eight in the morning the Turks renewed their attack, but this time against our right wing; the company of chasseurs, and the company of Esthonians, ambushed under cover, received their assailants with a severe fire at very short distance. The Turks stopped, lay down in the vines, and covered us with a hail of bullets. Fresh troops tried several times to throw back our line; they advanced within 50 paces, but were each time repulsed. The last attack was particularly threatening, and it was necessary for us to call up part of the reserve. The 1st and 2nd companies of the 10th battalion of chasseurs, deploying to the right of the Esthonia regiment, advanced against the left wing of the Turks, whom they quickly drove back on the Montagnes Vertes. There was some trouble in stopping the first company of chasseurs, who allowed themselves to be carried away in pursuit of the enemy. Altogether six to ten tabors took part in this attack. Our men were led by Colonel Goolovina, commandant of the Esthonia regiment. The Captain on the Staff, Kouropatkina, especially distinguished himself among the skirmishers.

'To provide against fresh attacks by greater numbers, I made the following dispositions:—The Esthonia regiment kept its positions; its right wing was reinforced by the 9th battalion of chasseurs. The special reserve was reinforced by three companies of the 2nd battalion of the Liebau regiment. Two companies of this same battalion were placed on the extreme right, near the Tuchenitsa ravine, to prevent the enemy advancing along it. In the centre, facing Brestowets, the 1st, 2nd, and 3rd batteries of the 2nd brigade of artillery, and the long-range battery took up their position opposite the village. On the left were placed, in the lodgments, the 9th battalion of chasseurs and in the rear two battalions of the Liebau regiment. The reserves placed under my command were the Revel and Kalonga regiments, the 12th battalion of chasseurs, all the 4-pounder batteries, and the 3rd battery of the 2nd brigade, under the general command of your Highness. The

enemy made no fresh attack, and the troops remained quietly in their positions. At midnight I received the following order from your Highness :—" Lieutenant-General Zotoff orders the height which commands Plevna on the south to be carried to-day, 29th August. General Zutow calls this height the Third Crest. There are under your orders for this attack the following : The 2nd brigade of the 2nd division, the 9th and 10th battalions of chasseurs, the 1st, 2nd, and 3rd batteries of the 2nd artillery brigade, and the 3rd battery of the 3rd brigade. There are also ready to be placed under your orders, should you require reinforcements, the 1st brigade of the 16th division, which has received orders to cross the Tutchenitsa ravine, and to reach, at dawn, the height on my right wing. Major-General Dobrovolsky's troops are placed behind the village of Brestowets." In compliance with this order I sent to the troops under me the following orders for the next day's battle :—

' " 28th August, 8 A.M.

' " *Order for the line of battle of the Corps of Prince Imeretinsky, of His Majesty's Staff.*

' " The Revel and Esthonia regiments, the 10th battalion of chasseurs, and all the guns in battery are to keep their positions.

' " The troops of the 1st line take all the precautions necessary in face of the enemy.

' " I call the attention of the troops of the left wing to the massing of the enemy's forces behind the redoubt and facing our left wing.

' " The 9th battalion of chasseurs and the Revel battalion placed in rear of Brestowets must send some water-carriers to Brestowets, where six companies of the Esthonia regiment are posted, and to the spring where the Cossack regiment of Vladikavkaz is placed. The Revel regiment is to take post on the road, in advance of the artillery, one company as a picquet, which will spread out to the left of the road as far as the village of Brestowets, where they will communicate with the Esthonia regiment. Colonel Chernozouboff will guard the left flank beyond the Lovcha and Plevna road against all the attacks which the enemy may make from this side.

' " In case of a night alarm, the troops of the 2nd line must not, under any pretext whatever, open fire, but simply await orders where they are.

' " Should this happen, the artillery will direct their fire according to the observations made during the day.

' " The troops must hold themselves in readiness for an attack

to-morrow morning, and with this view I require the following instructions to be followed :—

'"(1) All commanding officers must take care that the men have an early breakfast, and that each one takes a pound of cooked meat. In every case the *sotniky* Geitoff of the Cossack regiment of Vladikavkaz is ordered to supply the Revel and Esthonia regiments, the 9th and 10th battalions of chasseurs, and the artillery at the rate of two oxen per regiment, and an ox per battalion, or per two batteries. These cattle are to be handed over to the regimental cooks, under the superintendence of the *sotniky* Geitoff.

'"(2) To furnish the several corps with ammunition and ambulance waggons, and sanitary detachments, and to give to the men packets of cartridges, which they will put in their pockets and in their *bashliks* (*hoods of cloaks*).

'"(3) They must take care to fill up the water-cans before the troops are brought into the line of battle, and for this purpose tell off a fatigue party with the necessary utensils.

'"*Notice to the Men of the* 1*st Line.*—For troops placed to the left of the road the nearest water is at Brestowets, and then at Krishina; for troops placed to the right of the road, in the ravine in rear of the post of the Esthonia regiment, then on the road at the last height in front of Plevna.

'"(4) This night I myself remain on the road in front of the Bogot ravine.

'"In case of attack supplementary orders will be given on the spot.

'"*Notice.*—The 1st brigade of the 16th division passes the night in rear of our right wing, in the ravine."

'At daybreak on the 29th of August, the Esthonia regiment, supported by the 9th battalion of chasseurs, pressed forward to occupy the Second Ridge. This height was carried after an interchange of a few musket shots, and I had it entrenched immediately. I did not intend to approach the Third Ridge the same day, in order not to engage all the troops, and not to expose them to a fight against odds before the time came for a general attack upon the fortified camp at Plevna.

'One important cause of these delays in making the attack was the evident necessity of entrenching the positions gained, a work which did not fail to give rise to considerable difficulties, owing to the lamentable insufficiency during this campaign of tools at the immediate disposal of the troops engaged. The men scraped up the earth by the help of the lids of water cans and with their hands. The vines were also torn up by hand to clear the glacis (ground swept by fire).

'The importance which this question of preparing and entrenching fields of battle has assumed in actual warfare is my excuse for making some remarks on the subject.

'Infantry soldiers after any brisk action return for the most part without tools.

'A soldier of our army, when he advances to the attack over difficult country, especially on a hot day, relieves himself first of all of the entrenching tool; he throws it away, his great coat follows, and, lastly, his bag of biscuits. Thus, when the troops obtain a position which they ought to hold, they have no longer the means of covering themselves from the enemy's fire, as infantry have often protected themselves in the War of Secession, during the four sanguinary years of the Carlist war, and in this war also, where it is the regular practice of the Turks.

'It is impossible not to call attention to the inadequacy of the means placed at the disposal of the force for the construction of field works. In an effective strength of 20,000 men in your Highness's corps, we had, and that only by chance, but one detachment of 35 Sappers and a sub-officer under one solitary officer of Engineers, although our Academy of Military Engineering supplies yearly scientific officers by the dozen. Considering the weapons now carried by infantry and the relative inefficiency, so far as actual results are concerned, of long-range artillery, it appears a matter of certainty to me that if the French armies in the second period of the war of 1870–71 had kept strictly to the plan of occupying strategic positions (directed by preference against the lines of communication), combining with this a strictly defensive system of tactics, assisted by field fortifications, the campaign would have had a result more favourable for the French.

'When the Second Ridge was occupied by the Esthonia regiment and the 10th battalion, I placed in rear of it the 1st and 2nd batteries of the 2nd brigade of artillery, and I brought to the position the Vladikavkaz regiment of infantry with the Souzdal regiment in reserve. The troops were disposed as follows :—

'The 1st battalion of the Esthonia regiment occupied the trenches on the right of the batteries, the 2nd battalion and the skirmisher companies of the same regiment the trenches on the left in line with the artillery and opposite Krishina. Four companies of the 3rd battalion defended the second line of lodgments. The 1st battalion of the Vladimir regiment, on the left of the 2nd battalion of the Esthonia regiment, took possession of the trenches opposite Krishina with three companies in a line of lodgments. The 2nd and 3rd

skirmisher companies of the Vladimir regiment protected during the night the position of the batteries.

'The 10th battalion of chasseurs occupied a certain position on the right wing (in rear of the road towards the Tuchenitsa ravine), with two companies in the 1st line and two in the 2nd, both sheltered in trenches.

'The Souzdal regiment formed the general reserve and was placed in rear of the First Ridge, covered with vines, on the right (east) of the road from Lovcha to Plevna.

'At the moment when the troops took up these positions the enemy opened a very brisk fire upon us from the Krishina redoubt, and those on the southern face. We answered it with effect from two batteries placed behind epaulements.

'During the night the Turks twice tried to force our line of entrenchments, once in front, the second time by our right flank towards Krishina, but these attempts, made as they were but feebly, were easily repulsed, without loss on our side, by the fire from the shelter trenches of the Esthonia regiment.

'On the evening of the 29th of August I was informed of the arrangements made for the Western army, fixing the general assault on the entrenched camp for the morrow, 30th of August.

'With this object I received the special command of a detachment composed as follows:—1st brigade, 16th division, Major-General Tebiakina; 3rd brigade of chasseurs, Major-General Dobrovolsky; the Revel regiment of the 2nd division of infantry, three 9-pounder batteries, and one 4-pounder battery.

'(Signed) Detachment Commander,

'Lieut-Gen. Skobeleff.'

PERSONAL EQUIPMENT.

By Captain T. Fraser, R.E.

If the destruction of others be the most important branch of the art of war, that of keeping oneself alive is not the least. With this object, the following Notes on Equipment have been put down on the chance of their being of use. They are based on the experience of many months lately spent in European and Asiatic Turkey during summer and winter.*

To the Notes has been added a list of what has been found useful; and to save inquiries, and also the time of those who may have to get their kit in haste, other particulars have been given where it appeared desirable.

The first impression that the list of equipment is likely to produce is, probably, that it contains more than can possibly be required. The answer is, that the list, which has been framed to meet a number of requirements, is chiefly suggestive and must be modified according to circumstances. Travellers or officers working independently of a field force must have some special object in view and have certain difficulties to deal with. In their case, therefore, the carrying arrangements must be made to fit their requirements within reasonable limits; and notably in the matter of food, they may even have to exceed the total amount (32 lbs.) given in the list; while with a well-found force, a much less quantity would be enough for the officers who accompany it. Similarly, when a limit of weight is strictly adhered to, as it ought to be, officers must use their own judgment in selecting what it is best to take. In Egypt, for instance, where it does not rain for more than three or four days in the year, waterproofs are not wanted, nor warm clothing. Again, there are many things that always accompany troops; this relieves the officer of the necessity of taking them.

* In reprinting these Notes considerable additions have been made; and the Author has to acknowledge the help he has received from Col. W. O. Lennox, V.C., C.B., R.E., and from Mr. F. M. Sandwith, who was on the Medical Staff of the Stafford House Committee.

By the regulations of our service, based on the carrying power of wheeled transport, officers are, according to rank, to have from 40 to 80 lbs. of light baggage carried along with them, and in addition about 20 lbs. of cooking utensils for messes of three officers. They will further each be allowed a bullock trunk to hold about 100 lbs. of personal baggage, which, however, is generally to remain at the base.

In Turkey, where wheeled transport is often impracticable, some modifications would, it is thought, be necessary.

Bearing this in mind, the things in the list have been put down in the supposed order of importance, and have been classified as :

(A) Those that officers and others should try to take with them, from day to day, and never part with if possible.

(B) Those that, if circumstances permit, they would try to have carried forward, so as to be available whenever the troops make anything of a halt, and the baggage trains close up.

(C) Those that would be left at the base and would serve as a depôt to draw upon as opportunity occurred.

(?) Those required exceptionally and which may be dispensed with most readily.

The list has been framed, in the first instance, chiefly to meet the requirements of a mounted officer when detached. For regimental officers certain reductions will be suggested.

When troops are continuously in movement, officers will, it is thought, find that, in the countries in which these notes were taken, the equipment marked A will be about all they can get along with them ; and they may think themselves lucky if they can pretty often get at that marked B, and replenish list A.

Remarks on the Materials of a Kit.

Luggage.

All luggage should be marked conspicuously with the owner's rank, name, regiment, and division. The locks should be good, and there should be duplicate keys.

In civilized countries, where wheeled transport can move with ease, any handy case answers the purpose, and weight is of less extreme importance. But with troops in the field, in countries where roads are few, and the carrying power of those that exist is constantly overtaxed, it is generally necessary that baggage should be carried on pack animals, if you are ever to have it when wanted. With pack animals a small limit of size in the packages is necessary, particularly in difficult country.

Where a little extra weight can be afforded, perhaps the best kind of bullock trunks are the regulation wicker-basket cases, covered with painted canvas. Each of these cases should have a wicker-tray, such as women have in their boxes, to save having to empty everything on to the mud, in case what you want is at or near the bottom.

White's waterproof lock-up bags are the lightest things that are serviceable, which they certainly are, and when a small limit of weight is allowed they are, perhaps, best. They should be furnished with pack-saddle straps, as ropes cut them and injure the contents. They are intended to hold a camp-bedstead; but when this is carried on the march, it is better to have it in a separate waterproof cover to save the trouble of emptying the bag each night in order to get out the bedstead; besides which, mud sticks to the bedstead, and thus goes into the bag, which is inconvenient. This arrangement is a necessity with the bullock-trunks, which are too short for the bedstead.

A soldier's waterproof kit-bag is a useful addition to one's baggage, as, if necessary, it holds enough for a few days at a time.

In moving to the base of operations mounted officers require a saddle-box. This should be light and not very large, and should have a good lock. It can be left at the base as a store-box. If lined with tin it is all the more efficient for the latter purpose.

A tin uniform case is also a suitable thing to leave at the base, to hold reserves of equipment. Officers who can only carry forward one bag or case might leave a tin case at the base instead of a bullock-trunk.

Horse Appointments.

In the East, horses are small compared with ours, so that for country horses, girths should be shortened three or four inches before starting, say to forty-two or forty inches from buckle to buckle, and head stalls and bridles should also be of small size.

The English hunting saddle is very well in this country, where there is something between skin and bone, but for long-continued marching the secret of avoiding sore backs is to have a *large bearing surface*. This the Turkish saddle provides, and, clumsy though it be, it causes less damage than our hunting saddle.

Our new regulation saddle with fans seems excellent. Two pockets or saddle-bags (one only is regulation) will be found very useful with this saddle. The pockets should be so strapped to the saddle as to be readily taken off. This is often necessary at the end of the day to secure the contents. If it be necessary to carry a

pocket on foot, two cloak straps make a shoulder strap. The new wallets are fixed to the saddle without a girth.

A breastplate is useful in a hilly country, such as Turkey, to keep the saddle from shifting back. It should be small for Turkish horses

Stirrups should be large enough to be used with the largest boots: for instance, even with indiarubber or fur-lined boots.

The Numnah is another product of civilisation that should be got rid of. The best plan, it is thought, is to have a suitable horse-blanket to fold under the saddle. For riding, the roller (without pad) is passed round saddle and all.* The folding of the blanket should be constantly altered, and all caked dust and sweat should be scraped off; when a sore back is feared, the folds can be arranged to take off the pressure. Whatever happens the horse has his cover, and for Arab horses in cold weather this is even more important than for ours, as they are accustomed to a much heavier and warmer blanket. The Roumelian horses bear cold and wet much better† than Arabs. The Turkish shoe is good in snow, as horses *ball* less with it, and it is more easily replaced in the country. Grease on the soles of the hoofs also prevents balling.

Some form of waterproof saddle-cover is necessary for officers whose work obliges them to dismount much. In bivouacing, too, it is important to keep the saddle dry. The new regulation saddle-sheet (4 ft. by 3 ft.) answers the purpose. A nosebag to hold a feed‡ should always be taken on the march. If you are accompanied by a man on a second horse, the man can take it, but if you are likely to part company with him, take it yourself. Heel ropes are very necessary with stallions, and pickets and ropes are required when camping for any time. Instead of carrying heavy wood or iron pickets, if the picket rope have 3 ft. of light chain (with a ring) at each end, then any small bit of wood, or a small faggot, buried in the ground, will do to secure the ends. No horse can draw a picket buried horizontally 8 or 10 inches under ground.

The pack-saddles in the country often suit the local cattle best. Much depends on girthing the saddle securely, and in dividing the load evenly between the two sides (with as little as may be on top), so as to

* Capt. Gill, R.E., tells me that when girth-galls give trouble, this roller, used like a racing surcingle, answers without the girths and grips in a somewhat different place. A longish roller is required. The Austrian cavalry use a sort of felt blanket, folded in four, that answers well.

† Horses accustomed to bivouac if put for a night or two in a close stable are apt to catch cold when out again in cold weather. An open shed, however, is an advantage.

‡ Barley is the usual corn for horses in Turkey.

prevent its shifting. The drivers with pack animals always seem to think that their weight, added to that of the load, helps the animal: this illusion should be discouraged. For a pack-horse, 200 lbs., including pack-saddle, is a very full load. With 160 lbs., a march of 25 miles in a day is an effort; but 20 miles can be kept up for a week. For a long journey 80 lbs., besides the saddle, is enough for these small horses. The pace is about $2\frac{1}{2}$ miles, including short halts. When a party starts for a long ride the pack-horses should not be overladen, for, though the food is consumed, some horses are sure to break down, and their loads must be distributed. In buying horses, look out carefully for chronic sore backs and for blindness.

Furniture.

In order to be raised a little above the mud, and as a protection against fever, a light bedstead is a most valuable piece of furniture. White's camp-bedsteads certainly stand very rough usage. The screws should be put in well or they drop out in hot weather.

A hair-mattress is a bulky luxury. If there be transport enough, take a second blanket (not a blanket-bag), which is less bulky and more generally useful than a mattress, and in very cold weather is almost necessary; though by sleeping in all one's clothes, in a blanket-bag with the waterproof cloak over all, one is generally warm enough. Of course the bedstead must often be left behind, and then some much more portable arrangement is required. Cork-mattresses and full-sized air-beds are too bulky to take on one's own horse; and a separate waterproof sack to lie in seems unnecessary, as the regimental waterproof cloak acts as a ground sheet. All that can be desired is something on which to rest the head and trunk. An air cushion 40 in. by 21 in. is large enough for this, and even if it fail as an air cushion, it still acts as a double sheet under the body. A blanket-bag and a kit-bag should be taken with the cushion, so one's bedding only weighs 9 lbs. At night one gets into the blanket-bag; puts on the waterproof cloak, and lies on the inflated cushion; and when it is wet the feet are thrust, blanket and all, into the soldier's bag. It is best to have the blanket-bag open at the foot, but made to button or tie up. Then, if it be not safe to take off one's boots, one can get into and out of the bag more conveniently. If it be very wet, the boots, when off, can be drawn under the waterproof; the head is covered with the nightcap and the hood of the cloak; the helmet may get wet, it dries again quickly. The holsters, saddle, and pockets are kept dry with the saddle-cover. In very cold weather a buffalo or opossum skin bag is warmer than a blanket, but is more

bulky to carry. All bags should be turned inside out each morning and shaken.* Officers who have to write much want a small table and stool (when they can get them). The *pine* tables by White, with thumbscrews or spring clips to secure them, are the best. A chain-chair is seldom practicable (White's folding chain-chair is the best of its kind), but a 2-lb. four-legged stool, to fold into a stick, can generally be managed with the baggage.

Sheet indiarubber basins and baths are the most portable and answer perfectly; inflated ones are not necessary.

In rapid movements, or in extreme cold, or when water is precious, the use of the tub ceases to be a custom and becomes a ceremony. It is then enough to carry one tub for several people. A small-sized one is preferable.

A small looking-glass is useful, and necessary for those who shave; few do.

If tents be used, a pole-strap, and, with each detached party, a hand-axe, a picket-shovel, and a mallet are wanted. Regimental officers can depend on the pioneers.

A tarpaulin floor cloth to a tent is a great benefit when it can be carried. In estimating for tents, take their weight when wet.

Clothes.

In the list, the supply indicated is intended for a few months, the articles being new to start with. If for a longer time, a reserve in proportion should be taken out. In the same way, according to the season, clothing should be thick or thin. In European Turkey the shade temperature ranges from 100° to 0° Fahrenheit in the year; and though the days in autumn are very hot the nights are cold. In summer a thin flannel shirt and thin Indian gauze drawers are enough underclothing. In winter, the thickest woollen drawers (two pairs if possible) and vest, with two thick shirts, or a shirt and knitted waistcoat, are just comfortable; and at such times people wear furs, if they have them. A cholera belt should always be worn—a fine flannel bandage that goes twice round the stomach is best.

For exploring parties, or officers not on military duty, a shooting coat with many pockets (or Norfolk shirt), waistcoat, and breeches is the most convenient dress. These would take the place, on the list, of patrol jacket and pantaloons; and a white cashmere handkerchief does duty for the collar of civilisation. In all cases, even when in plain

* In riding lately from Constantinople to Gallipoli, through deep snow, Col. Home took a buffalo robe, and the author a bedstead. At first Col. Home had the best of it; but afterwards he forgot to shake the robe!

clothes, a regimental waterproof cloak with a hood should be carried; a long light overcoat, with hood, takes the place of a regimental one for men not in uniform. A grey felt helmet with chin-strap is the best head-dress, except in very cold weather, when a fur cap with ear-flaps (to be down or up) is warmer, and the head can then be covered with the waterproof hood as well.

If in uniform, the regulation white helmet would, it is presumed, be worn. In mid-winter a forage-cap, with a Canada-pattern fur cover, might be more convenient. Helmets should be tried on with hair cut short as it would be.

For duties where much walking is combined with riding, shooting boots and leather gaiters are most convenient, as it is more fatiguing to walk in long boots. The best shooting boots are made with the thickest possible solid *single* soles. These are less stiff than and last as long as the heavy soles often used. Nails do not save the soles, and it is better to be without them when riding. The so-called porpoise hide laces are well worth the extra expense. The regulation boot is the best for riding only, except in wet weather, when the drip from the waterproof wets the feet. Indiarubber boots are then the most comfortable; they are unfit for much walking, and are slippery in snow, but are a great protection in mud and slush. The best arrangement perhaps, but one as yet untried, would be to have a pair of short black waterproof gaiters, ancle high, to cover the whole of the feet down to the soles, with a leather strap under each sole near the toe to keep the gaiters in place; the gaiters would be fastened behind with two straps, one above and one below the spur; they would keep off the drip from the waterproof and could be at once taken off for walking; they would occupy no space when carried on horseback, and are quite as suitable for shooting boots as for the others. Boots, if well greased or dressed, will, for a time, turn water, but not entirely. All boots for riding should be large enough to take two or three pairs of thick stockings or socks. Riding boots should be easy enough to be got on and off without boothooks and bootjacks. Thin canvas boot-bags are convenient for boots carried in luggage. For marching, grease or soap rubbed on the feet and on the insides of socks prevents blisters. Always try to change socks at the end of the day. New socks last longer if darned at the heels and toes.

There is a good deal of wet weather in Turkey for two-thirds of the year, and the regimental waterproof cloak is then the most valuable article of dress. For a mounted man it cannot be too long; and it should be strengthened at the fork and at the junction of the cape and coat with leather splices. In the latter case this makes the

hook secure. A thin strip of leather round the lower edge of the cloak prevents its fraying. The cloak should have a removeable waterproof hood. In severe weather the people of the country always protect their heads with something more than a cap, particularly when sleeping out, and this the hood does perfectly. With this cloak and with waterproof boots, one can do without a change of clothes for a week or more, even in wet weather.

The regimental greatcoat is less useful than the waterproof, and is generally assigned to the baggage. In winter one is glad sometimes to wear it, with the waterproof as well. If the coat be worn without the waterproof, a removeable cloth hood is an advantage; but of the two the waterproof hood is the more generally useful. The coat is a serious addition to the weight dismounted officers have to carry: it should have buttons on the collar for the cloth hood.

The patrol jacket, whether blue or red, should be large enough to allow of two or three shirts being worn underneath. It should have small outside breast pockets on each side, for a watch and pencil. The chains for these pass through holes in the bottoms of the pockets, and are secured to rings inside the coat. With such pockets the articles can be taken out without opening the coat, a great convenience when mounted. All the pockets should be lined with leather, and the side pockets should be large enough for the notebook. If a regimental waistcoat be taken it should have red serge sleeves; then, except in very cold weather, it acts as a mess dress.

Pantaloons for winter should be loose enough for winter underclothing. Dismounted officers would have trousers instead. Trousers converted to breeches are much more comfortable with gaiters than trousers are. Each brace button should have a duplicate sewn on beside it. If buttons carry away, people don't sew on new ones but go without. Roomy fob pockets in the pantaloons or trousers, large enough to put one's hand in, are convenient for purse and keys. Black doeskin is the best material for strapping pantaloons.

All pockets should have buttons to close them; as, otherwise, when sleeping in one's clothes, things constantly fall out.

In extreme cold there is nothing like fur. By having patrol jackets and greatcoats made very large, fur linings can be put into them in the country. Wolf skins are common, and are said to discourage insects. Sheepskin stockings (wool inside) can be used inside the large indiarubber boots, and are a great protection from the cold: they may be long enough to come over the knee. Similar stockings of blanket to go over riding boots are also much used in the country

A cummerbund or silk sash wound tight round the waist is a support in riding (though with a cholera belt it is not a necessity, and has certain disadvantages); it also saves the drag of the sword belt on the stomach. This is also lessened by using a sword sling under the coat. A soft leather or broad web sword belt (but with regulation slings) is most comfortable, and, except with a tunic, should be worn if it be permitted.

The face net used in Ashantee, which can be worn with or without the helmet, would sometimes be a convenience in Turkey. Though mosquitos are not excessively troublesome there, flies are; and in the neighbourhood of carrion are sometimes fatally poisonous. If you have nothing else, a piece of muslin 3 ft. by 4 ft. to lie under is a great protection to the face and hands. Mosquito netting is a slight protection from malaria. Soldiers must get on with the insects they meet, but explorers may sometimes indulge themselves in the luxury of insect powder.*

In standing camps, a pair of slippers of red canvas with india-rubber sides and soles are convenient, as one can go out in them at night if necessary.

When stationary with one's baggage, the best plan before dining is to dress for bed. That is, put on the other flannel shirt and drawers and a pair of light flannel trousers. Some prefer pyjamas with feet, as being more puzzling to insect life: trousers or drawers should be tied round the ancles, and socks should be worn when sleeping. It is much safer to be too hot than too cold. In hot weather the blanket is only put over the feet and is pulled up when the morning chill comes.

Woollen underclothing should be shaken and aired constantly.

Except when sleeping in a house, all clothing should be put into the luggage each night, to keep it from getting wet with the dew.

Cooking Utensils.

20 lbs. of utensils are supposed to be carried with the baggage for each officers' mess of three. When they do come up it is important, in campaigning, to be able to cook quickly, and the fundamentals for cooking are—first, a kettle (White's are excellent, being flat, and suitable for wood embers); second, a frying pan.

A tin stewpan is also a convenience when vegetables are found, or

* Pyrethrum Roseum (Savory and Moore), in a sort of pepperpot, answers well. People sometimes put each foot of their bedstead on a piece of paper and put a ring of the powder round the foot; saving the powder each morning. Flies may be driven out of a tent by firing a little gunpowder in it.

rice is to be boiled. The canteen case of galvanised sheet iron serves to boil water for washing, &c. Copper cooking vessels are dangerous. The enamelled plates and cups White supplies are very nice, but the cups do not pack well, and when weight is important it is best to have two or three tin cups (with wire handles) which fit one within the other,* and to have tin plates as well. Every man is sure to have two or three friends to eat and drink with him pretty often, and they do not travel about with their plates as a rule.

Hence, though, if need be, one can eat with one's fingers and drink out of the palm of one's hand, still, when it is not necessary, much comfort is lost without cause, if one is stinted in these matters. So for each man 2 knives, 2 forks, and 4 spoons are desirable. Each canteen should have an eggcup per man, also a salt and pepperbox for the party, and a regular tin-opener (Lund's is the best), and a corkscrew for the servants' use. For frying eggs or meat the cook requires some lard or butter.

Could one be always sure of the canteen, and of firewood, nothing more would be wanted. But to provide for accidents, or the absence of fuel, an Etna is desirable, and should be carried with oneself. The one proposed boils $\frac{1}{2}$ a pint of water in 5 minutes, with $1\frac{1}{2}$ dessert spoonsful of spirit, or $\frac{3}{4}$ of a pint in 7 minutes with a little more. The spirit bottle holds 27 dessert spoonsful. The cap of the burner should be marked as a measure. Whenever firewood is available, it should be used to save the spirit.

Food.

For small parties moving through the country in peace time, meat or eggs can almost always be found; and with troops the bulk of the food will be provided by the commissariat. At the same time, the things put down, being more portable and more quickly used than ordinary rations, are well worth the carriage as a provision against accidents; though, as far as possible, one should live on what one can find, or on the service rations. It may be laid down as a safe rule *never to mount a horse or to start for a march without having some food with you as well as inside you.* Most of the extracts of meat are unsatisfactory: one wants something more than to be kept alive. Brand's extract, it is quite true, if added, say, to consolidated pea soup, carries one a long way.

* Baker Pasha had some excellent tumblers of toughened glass that stood everything. They reached the Rhodope Mountains, where they capitulated, I fear, unbroken! For want of better, food tins can be made into cups and pots.

One great difficulty is the want of vegetables; pea soup and rice are, in a measure, substitutes.*

Ship's biscuit is the best form of farinaceous food, and detached parties should carry all they can of it. Turkish biscuit requires to be soaked, and then heated on the fire to dry it a little; or it may be pounded. Much of the illness of foreigners is due to the bad bread of the country districts. In warm weather, tea is generally the most agreeable; compressed tea is the most portable. Tea should stand in boiling water for eight minutes; for early marching the liquor may be separated from the leaves at night and quickly warmed in the morning. Cocoa and milk is the most warming, but one tires of it. On the whole, coffee and milk is perhaps the best. Half-pound tins (those of the Anglo-Swiss Company are best) should be taken for marching, and a dry spoon should be used to take out what is wanted; otherwise the paste liquefies. Among the luxuries marmalade is the most prized, because it is healthful as well, and seems to check scurvy. Crosse and Blackwell's tinned marmalade and jams are excellent.† Brandy (or spirits) should be looked on as a medicine, and should only be used as such: otherwise, it is not a necessity in any way. There is at ordinary times a good deal of wine in the country, rather astringent but generally sound. It is best when 'mulled.'

Soldiers may consider themselves fortunate if they can get some of the above forms of food to make up for deficiencies. There are, however, many others that are suitable. For instance, good Menier chocolate in sticks or slabs is very portable and sustaining. Meat lozenges are also very portable when riding or marching. Sardines in boxes are also convenient, and may, with advantage, be grilled for a change. When one has diarrhœa, Liebig's extract ($\frac{1}{2}$ a teaspoonful to a soup-plate) with rice makes a good and suitable soup. Whitehead's soup-squares are also very portable, and make excellent soup.

Fowls can be plucked quickly if dipped into boiling water.

Tinned vegetables, such as peas; tinned condensed milk,‡ tinned butter, tinned oatmeal, and German sausages are among the luxuries one does well to get when they can be obtained at hand. Potted ham and bloater-paste are things to be desired. All the above, except compressed tea and meat lozenges, can generally be bought at Con-

* Rice one gets in the East requires to be sifted and then washed two or three times before use; it should be soaked for two or three hours and then boiled quickly; then strain off the water and let the rice dry by evaporation.

† Major C. J. East, D.A.Q.M.G., points out to me that the food tins in the French Army are each furnished with a wire loop so that they can be strapped on to the kit. This addition can easily be made at home.

‡ That of the Anglo-Swiss Condensed Milk Company is said to be by far the best.

stantinople. Coffee, made in the Turkish way, is always to be got, and is a strong stimulant. The coffee is boiled in a little pot of water till a creamy froth comes on the top, then a few drops of cold water are poured in to settle it, and sugar is added in the pot.

A good deal of fruit is to be found in the country in summer; but melons and cucumbers have not a sanitary effect. The country people believe water-melons to be harmless, but they promote diarrhœa; all unripe fruit should be avoided. There is a fruit called Kuzeljick, like the cornelian cherry of the West of England, which is astringent, and, when eaten, checks diarrhœa. A syrup is also made by boiling the fruit, and is taken as a medicine.

Grape skins, being indigestible, stave off hunger; so does 'smoking.' In Turkey the tobacco is only fit for cigarettes: for these a supply of papers should be taken.

It is best to filter all 'unknown' water. The pocket-filter, with a double length of tube (the longer the better) as a syphon, can be used conveniently in a bucket. The metal-covered filters of the Silicated Carbon Company are smaller, cleaner, and stronger than the plain carbon blocks.* Where troops have been engaged, search the streams for dead animals, and the wells for corpses.†

The usual supplies of water in Turkey are in the form of fountains, with spouts emptying into stone horse-troughs. The pipes leading to the fountain are generally under ground and difficult to trace.

Leather or canvas water pack-bags require aprons to protect the animal from the wet.

Books, Stationery, and Instruments.

A Prayer-Book may be wanted to read the Burial Service.

The most portable Turkish Dictionary is Redhouse's Turkish Vade Mecum. There is a larger one by Sawerwein (Williams and Norgate); and a grammar giving equivalent Turkish, English, French, and Italian sentences by Viotte (Brockhaus, Leipzig). Thimms, of 24 Brook Street, has a small new grammar, by Abu Said; and there is an older and larger one by Major C. Boyd, printed by Smith and Elder, of 65 Cornhill. The Intelligence Branch has just got out a very handy one for English, Russian, and Turkish.

The map (generally calico) should be ruled in squares, each side

* An exploring party with ample transport should also take one of their Army medical filters (7 in. by 7 in.), weighing 9 lbs.

The small filters should be constantly washed, boiled, and baked, or they become useless. With very dirty water, the filter may be used in a pocket handkerchief or bit of canvas.

† At Sedan in 1870, and at Karahassan Keue in 1877, wells were thus polluted and used in ignorance.

a mile, or some sub-multiple of a mile (unless the scale be very small). The lines should be magnetically N. and E., so that, with a compass and a protractor, places that can be seen may be identified.

Graphine is the most portable form of ink—a small piece put into water makes enough to fill a bottle—but the solid ink fountain 'Perfection' penholder promises to answer best for campaigning, as it only requires water, and the ink it produces acts also as copying ink. It is best to carry this kind of graphine as well as the pen.

A sketching case should have a thoroughly efficient waterproof cover. Tough bank-post paper with blue lines should be taken for sketching. Large notebooks 8 in. by 4½ in. are convenient in wet weather.

Scale (logarithm) paper is invaluable for officers who have to make sketches of details. Notebooks should be made of this paper.

The shading of ground is much more quickly and easily done with a pencil and stump than in any other way.

The compass should have a small socket that will screw to it. This allows of its being stuck on the top of a stick, so as to be steady. Any rough stick can be cut and used in this way. Elliott, in the Strand, makes these sockets.*

A sextant is occasionally useful, as on shipboard, where a compass is thrown out.

Officers, particularly when detached, require to keep copies of reports in order to refer to them again. Van Anden's roller copying-press is the most portable. Copying books (foolscap size) are required as well.

Military attachés and explorers do well to take meteorological observations daily. Casella makes admirable maxima and minima pocket thermometers in ebonite cases for the purpose.

Medicines.

In addition to the graver ailments—such as typhus, typhoid, cholera, and acute dysentery—diarrhœa, dysentery, and low fevers are common. When bad diarrhœa begins, avoid meat and bread; use only milk or filtered water; take rice and rice water, and keep warm. A dose of rhubarb sometimes cures it; a good dose of chlorodyne is also an efficient temporary remedy when on the move. Collis Browne's chlorodyne is said to be the best. The doses mentioned on the instructions may be exceeded by a quarter with safety.

English doctors in Turkey found that, at the beginning of

* Engineer officers with field companies should see exactly what equipment they have with their company, so as to avoid taking what is not necessary for themselves—a pocket sextant, for instance, or stationery of certain kinds.

dysentery, a dose of castor oil often cured it. Ipecacuanha is also useful.

Good quinine (sulphate) becomes scarce in a big war, so a small supply is perhaps worth taking. Learn to judge what, say, 5 grains look like on your hand, and lick them up out of your hand, taking some water to wash the quinine down.

Officers, when likely to be engaged, should take a piece of lint with the calico bandage. A litter can be made with 2 muskets and a great coat. The barrels are put into the sleeves, and the skirts are fastened round the stocks with strong safety pins.

The silk pocket handkerchiefs should be large enough to act as slings for wounded arms.

In the absence of a doctor it is worth while to carry some of each of the remedies marked A and B. Carbolic oil (the acid and olive oil being as 1 to 10) is also useful for dressing sore backs, heels, &c.*

Sundries.

A common 'second' watch is most useful. Even if the first do not break down, it is often necessary to lend one to servants, &c. The 'best' watch, at all events, should have a seconds hand. A repeater is very convenient at night, as it saves striking a light. The same key should do for both watches.

The Engineer signalling telescope is an excellent one. In very damp weather it sometimes draws out badly: a little grease prevents this. The best field-glasses are not nearly as efficient, though useful to catch objects.

The soldier's wooden water-bottle, fitted with light leather straps, is about the best there can be: it keeps water cooler than the ebonite bottle. It also forms the best store bottle for brandy in one's baggage. A soft wood plug should be pushed from the inside into the metal mouthpiece, as the ordinary plug is apt to be knocked out when carried in the luggage.

Chesterman's steel metre and yard measure answers for all purposes. It measures the girth of trees, and with it a sounding or measuring rod or string can be marked for use. Officers do not want tapes: 'pacing' is good enough for war.

A pocket-lamp is frequently required. The twilight is so short in Turkey one is constantly caught, and it is often necessary to dismount and hold a light to the ground to find the track. One should be able also to write and read an order on the march. It is best to take

* The Spanish muleteers believe in a still simpler (saline) application for this purpose.

regular lamp candles, as they burn longer than others. They should be economised by burning common candles (they can generally be got) except out of doors. In camp the lamp candle-holder acts as a separate candlestick. The cylindrical railway lamp, with revolving outer body, is the best, but it wants a cap with a grating for use in the open air. Salsbury makes these.

Brass dish candlesticks that screw together are the most portable. Only the scribes want them.

The knife should have a strong horse-picker, a leather punch, a tin-opener, screw-driver, corkscrew, and small tweezers, and, if gaiters are to be worn, a button hook. The big blade should have a spring stop.

Thick Turkish towels hold most water, and in damp weather can be used undried much longer than others.

The money in Turkey is the greatest of many inconveniences.

There is a gold *lira* (worth about 18*s.* 2*d.* English) of 100 gold or theoretical piastres; and there are gold half and quarter liras. The pure silver coins are the Medijide of 20 (good) piastres; the Beshlik (Cherik) of 5 ditto; and also one and two-piastre pieces.

Theoretically there are five Medijides to the lira; but the value of silver varies constantly, and the lira is always worth more than 100 silver (good) piastres. Again, there is a mixed metal coinage, the largest piece of which is worth 6 copper piastres. This coinage is often refused, and should always be avoided. If you have to use it keep one piece of each size with its value scratched upon it. Next comes a copper coinage of piastres of a rather less value than the silver (good) piastres. Its lowest subdivision is a *para*, the $\frac{1}{40}$th of a piastre. There are as well pieces of 5, 10, and 20 paras in copper. This coinage also is not always taken up the country.

Lastly, there is the paper money (Caimé). The most common notes are *marked* 1, 5, 10, 20, 50, and 100* piastres. These are the theoretical values. There is also the *conventional* value, which is slightly greater: thus a 100 piastre note is taken as 120 piastres. Thirdly, there is the diurnal or market value, which represents the depreciation of paper. Thus, for a lira you may often buy 260 conventional paper piastres.

Except in the shops of Pera and at the railway and telegraphic offices, where silver or gold is required, paper is taken all over the country at its *conventional* value, and when a price is named this value is the one referred to.

* The Arabic numbers used in Turkey are written and printed thus:—

١ (1), ٢ (2), ٣ (3), ٤ (4), ٥ (5), ٦ (6), ٧ (7), ٨ (8), ٩ (9), . (10).

The numbers on watches thus:—

V (1), V̇ (2), V̈ (3), V٤ (4), O (5), V̇ (6), VV (7), ΔΔ (8), ΔV (9), . (10).

Travellers do well to take some gold, a little silver, and a good deal of paper money.

Estimate roughly what the conventional value of the paper is worth at the price paid for it when reduced to francs, and think in francs.

Thus, if for a Napoleon you buy two 100-piastre notes, these are conventionally worth 240 piastres, and consequently 12 piastres equal 1 franc.

If you have the misfortune to be obliged to keep accounts, reduce every entry to francs at the time.

In working with a dragoman he can reduce everything to, say, 'gold' piastres.

The chief measure of weight, both for solids and liquids, is the Oke, of 2·84lbs. English. Eight Kilehs = 1 English quarter of grain.

The chief measure of length is the Arshin (Levantine 'Pic') of 29·5 English inches (75 centimetres), or 24 Parmaks (Turkish inches).*

Modes of Carrying Equipment A.

For a mounted officer, and particularly a Staff officer, it is important that, whatever breaks down, he may be able to go on, as long as he and his horse stick together. The following arrangement is therefore suggested, and bearing in mind that the wallets may remain on the saddle, it is best to put the many small articles into the saddle pockets. Flasks particularly, and occasionally revolvers, have an unaccountable way of getting emptied if out of one's sight. They should be looked to each morning, and so should the water bottle :—

In saddle cover as valise (9 lbs.)	In 2 saddle pockets (11½ lbs.)		In or over wallets (14½ lbs.)	In coat pockets (1 lb.)
Kit-bag	Etna complete	Food	Waterprf. cloak	Dictionary
Air-cushion	Spoon & fork	Knife (clasp)	Revolver	Notebook
Blanket-bag	Cup	Comb	Water-bottle	Penholder
	Sponge & bag	Toothbrush	Food	Compasses
	Protractor	Medicines (A)	Telescope	Map
	String (30ft.)	Writing pad	Lamp	Watch
	Towel	Calico bandage	Compass	Pencil
	Shirt?	Filter?	Pocket-flask	Measure
	Diary?	Pair drawers?	Pair of socks	Keys
		2 spare candles?†	Nightcap	

* But there are Arshins and Arshins.
Another of 16 long Guirahs = 66 centimetres.
,, ,, short ,, = 64 ,,
If there be a question, refer it to your Chesterman's measure.

† In a small tin case.

The food is that marked A in the general list.

In moving fast it is inconvenient to carry the telescope and compass slung by the straps. A small strap on the compass case to secure it to the belt is most convenient when in uniform. In plain clothes an outside breast-pocket is the best place for the compass case. Officers accompanied by a mounted servant can get some of the above carried by him, and also some extra articles of List A.

The waterproof cloak is rolled and strapped over the wallets.

If it be likely the revolver will be wanted, it should be strapped in its cover outside the cloak with the near cloak strap. It is then at hand.

The water-bottle or telescope may be similarly attached.

In cold weather the regimental coat would be worn.

The blanket (in a roll about 21 inches long) and cushion should be put, at starting, into the kit-bag inside the saddle-cover.

In a battalion the three officers in each company might arrange Equipment A somewhat as follows, viz :

In kit-bag. For each (18 lbs.)	In mailcloth and linen haversacks (5 lbs.)		Separately. Each (11½ lbs.)
	Each (3 lbs. 3 ozs.)	Among 3 (5 lbs.)	
Blanket-bag	Food	Etna, complete	Revolver
Air-cushion	Pocket flask	Lamp	Telescope
Food (reserve)	Knife (clasp)	Compass	Waterproof cloak
Bath (1 for 3)	Fork	Protractor	Waterbottle
Basin (1 for 3)	Spoon	Writing-pad	——
Towel	Cup	Chlorodyne	Dictionary
Shirt	Nightcap	Tin coffee (½ lb.)	Notebook
Pair drawers	Pair of socks	Pea soup (6 ozs.)	Penholder
Comb and tooth-brush	Three bootlaces	Filter?	Map
	Calico bandage		Watch
Filter (2 for 3)	Cloak strap		Pencil
Sponge and bag			Measure
Tin of dubbing			Keys
Etnas (2 for 3)			
2 spare candles			

Each officer would thus have to carry 16½ lbs., including food and water. A mailcloth haversack with a broad web strap is most convenient.

The baggage in the kit-bags for 27 dismounted officers would weigh 486 lbs. This could be carried by 3 pack-horses (4 would be better, 2 to each half battalion).* These could accompany the battalion even when the transport for the canteens and for the balance of the baggage could not keep up with the troops. The articles should be put in the blanket-bags, or they may fall out.

Travellers should make arrangements with agents for the transmission of their letters. Most people find that weekly newspapers, such as *Public Opinion*, the weekly edition of the *Times*, and the *Pall Mall Budget*, are the best to have sent out.

Officers or others who may have important duties should never, in personal matters, do for themselves what they can get their servants or others to do equally well for them. They should save all their energies for their own work, and for the same reason should, while taking what is unavoidable cheerfully, avoid all unnecessary exposure and discomfort. Chills, and having to remain long in wet clothes, are the chief causes of illness apart from bad water and food. When in tents or huts, a special precaution should be taken against having to turn out at night.

Officers and others should always look as carefully after their servants' kit as after their own, and should see they are provided in a way to carry them through the extra exposure they may have to face, both as regards clothes and food. They seldom think of this themselves.

A servant wants a waterproof, a watch, and a blanket-bag; a squad-bag takes his kit.

T. F.

* The Russian cavalry officers appear to have each had a bat-horse in 1877–8, and the baggage of the infantry officers was carried chiefly on pack animals.

RIES FOR.

Those marked C a[re] marked ? are exceptional.

AND FOOD.		STATION	
Approx. Weight.	Approx. Cost.	No. and Des	REMARKS.
lbs. oz.	£ s. d.		
		1 Pair foldi	ything in this List can be got from the Army
		passes	, 117, Victoria Street, where arrangements
		1 Pocket Dict	to keep a sample set. A few additional
		1 Protractor .	
2 6	0 4 0	1 'Perfection'	ven.
		2 Spare „	
		1 Note Book 5	hite, Aldershot, where also samples can be seen.
			len, The Strand

of a smaller trac[e] which drains towards the Thame by the Tenfork

LIST OF NECESSARIES AND LUXURIES FOR CAMPAIGNING AND EXPLORING.

Those marked **A** to accompany the Officer always. Those marked **B** to do so when convenient. Those marked **C** as a Reserve or when in a Standing Camp near the base. Those marked **?** are exceptional.

LUGGAGE AND FURNITURE.

No. and Description.	How Carried.	Approx. Weight. lbs. oz.	Approx. Cost. £ s. d.
Bedstead Bag ..... ?	B (1)	2 0	0 15 0
Soldier's Kit Bag	A	1 8	0 4 9
Mule Basket, 24 in. by 11 in. by 15 in. deep inside ..... or	B (2)	18 0	2 5 0
Boat Bag..... ?	B (1)	12 0	2 15 0
FURNITURE.			
1 Air Cushion	A	3 0	1 5 0
1 Blanket Bag.....	A	1 8	1 5 0
1 Bedstead ..... ?	B or C	14 0	1 10 0
1 4-Legged Stool (Field's).....	B (2)	2 0	0 7 8
1 Table Complete	B (1)	6 0	0 14 0
1 Pole Strap..... ?	B	0 10	0 2 8
1 Bath and Case	A or B	2 8	0 17 0
1 India Rubber Basin	A or B	0 12	0 5 6
1 Looking Glass .... ?	B (1)	0 8	0 0 8
1 Sword Cover, leather	B or C	0 8	
1 Spare Blanket ..... ?	B or C	4 8	0 8 6
1 Folding Chair Chair ?	C (1)	5 0	0 15 0
1 Ground Sheet..... ?	?	3 7	0 15 0
		Totals. lbs. oz.	

HORSE APPOINTMENTS.

No. and Description.	How Carried.	Approx. Weight. lbs. oz.	Approx. Cost. £ s. d.
1 Regulation Saddle, with Thong, Girth, Surcingle & Shoe Case	A	17 8	5 16 6
2 Wallets	A	2 0	1 12 6
2 Pockets	A	2 0	1 12 6
3 Cloak Straps.....	A	0 8	0 3 0
3 Valise Straps	A	1 0	0 3 6
1 Saddle Cover	A	2 0	0 5 6
1 Spare Shoe & Nails	A	1 4	
1 Bridle Bridle & Bits	A	5 0	1 2 0
1 Headstall and Halter	A	2 4	0 7 3
1 Reg. Nosebag	A	1 3	0 5 6
1 Horse Blanket	A	7 0	0 13 6
1 Roller	A	1 0	0 4 6
1 Reg. Packsaddle....		50 0	4 15 0
1 Headstall & Halter	A or B		
1 Blanket			
1 Nosebag			
1 Spare Shoe & Nails			
1 Spare Halter.....	B	0 8	0 1 5
2 Roller Bandages	B	0 8	0 0 2 3
1 Curry Comb (for 3)...	B	0 8	0 0 7
2 Brushes (for 3)	B	1 8	0 0 8
1 Spare Fore Shoe.....	B	1 4	
1 „ Hind	B	1 4	
Spare Nails	B	0 2	
FOR CAMP.			
1 India Rubber Bucket	(1)	1 0	0 2 0
1 Picket Shovel ... ?		2 8	0 2 8
1 Hand Axe ..... ?		2 0	0 2 6
1 Shoeing Hammer ?		1 0	
1 Picket Rope ..... ?		8 8	0 2 6
1 Heel Rops	B or C	1 10	
2 Canvas Water Bags for carrying water on a horse; each for 8 gallons (per party)..... ?		5 0	
1 Mallet ..... ?			
		Totals. lbs. oz.	

CLOTHES.

No. and Description.	How Carried.	Approx. Weight. lbs. oz.	Approx. Cost. £ s. d.
Regulation Waterproof Cloak and Hood	A	3 12	2 8 6
1 Pair Riding Boots	A	5 0	1 16 0
1 Pair India Rubber „	B	5 0	1 8 0
1 Woollen Night Cap ...	A	0 2	0 1 10
1 Pair Shooting Boots	?	3 2	1 7 6
4 Spare Laces	A & B	0 1	0 2 0
1 Pair Leather Gaiters	B or C	1 0	0 6 3
3 Flannel Shirts		2 4	1 10 0
3 Pair Drawers	1 of	1 4	0 16 6
3 Silk Handkerchiefs	each A	0 3	0 0 6
5 Prs. of Wrstd Socks	Rest B	1 4	0 11 0
2 Pairs Stockings ...		1 2	0 8 0
2 Cholera Belts		0 10	0 8 0
1 Face Net Bag	A or B	0 0	(0 1 3)
1 Spare Pair Braces...	B	0 2	0 3 6
1 Pair Hunting Spurs	B	0 8	0 12 8
1 Pair Sleeping Trousers	B	1 0	0 8 0
1 Pair Canvas Shoes...	B (6)	1 0	0 2 6
1 Fur Cap ..... ?	B or C	0 6	
1 Cashmere Neck handkerchief ..... ?	A	0 3	0 2 10
2 Pair Woollen Drawers?	A	2 0	0 14 0
2 do. Vests . ?	A	1 8	0 13 0
UNIFORM.			
1 Helmet	A		?
1 Forage Cap	A or C		?
1 Sword Sling	A	0 1	0 3 0
1 Sword Belt	A		?
1 Cross Belt ..... ?	A or C		?
2 Patrol Jackets	A & B	6 0	9 0 0
2 Pair Pantaloons	A & B	3 0	
1 Pair Reg. Spurs ...	A	0 12	0 10 0
1 Cloth Great Coat ...	A or C	7 8	6 5 0
1 „ Cape ..... ?	A or C		
3 Pairs White Woollen Gloves ..... ?	A B C	0 6	0 0 0
1 Pair Bearskin Gloves?	A or C	0 0	0 5 0
1 Tunic ..... ?	A or C	3 2	
Evening Dress Clothes for travellers ..... ?			
		Totals. lbs. oz.	

COOKING MATERIALS AND FOOD.

No. and Description.	How Carried.	Approx. Weight. lbs. oz.	Approx. Cost. £ s. d.
1 Etna, consisting of— 1 Tin and Lid ..... 1 Burner and Stand 1 ½-pint Spirit Bottle 1 Match Box ..... 1 Strainer (net) ..... 1 Strap	A (4)	2 0	0 4 0
1 Spoon and Fork....	A	0 2	0 3 0
2 pnt Tins of Spirit ...	B & C(1)	2 5	0 6 0
1 Canteen Case, containing—			2 0 0
1 Tin Kettle ..... 1 Frying Pan ..... 1 Wire Gridiron			
1 Crk. Serw. (Stafer's) 1 Salt & Pepper Box			(0 1 3)
1 TinOpener(Lund's) 1 Turkish Coffee Pot 1 Small Meat Knife 1 Cook's Iron Fork & Spoon ..... 1 Small Soup Ladle	B for 3	15 0	(0 1 9)
2 Plates ..... 2 Tin Cups ..... 2 Spoons ..... 2 Small Spoons ..... 2 Knives..... 2 Forks ..... 1 Egg Cup.....	B	2 0	
FOOD.			
Compressed Tea.....	A (13)	0 1	
„ „	B	0 8	
„ „	C	2 0	0 8 4
Coffee and Milk in ½-lb. tins	A	0 8	0 0 6
„ „	B	3 0	0 0 30
„ „	C	4 0	0 0 40
Cocoa & Milk „	B	1 8	0 0 16
„ „ ...	C	4 8	0 0 46
Cooked Corned Beef in 2-lb. Tins	A	0 8	0 0 7
„ „	B	4 0	0 0 28
„ „	C	6 0	0 0 40
Brand's Extract of Meat.....	A	0 1	0 3 3
	B	0 4	
Consolidated Pea Soup	A	0 3	0 0 18
„ „	B (7)	2 0	0 0 16
„ „	C	3 0	0 0 16
Ships Biscuit	A	1 0	0 0 9 0
„ „ „	B	?	
Salt, Pepper, & Sugar	A	0 2	
„ „ „	B	?	
		Totals. lbs. oz.	

STATIONERY AND MEDICINES, &c.

No. and Description.	How Carried.	Approx. Weight. lbs. oz.	Approx. Cost. C s. d.
1 Pair folding Compasses	A	0 1	0 13 6
1 Pocket Dictionary ...	A (5)	0 3½	
1 Protractor	A	0 1	0 2 0
1 'Perfection' Penholder	A (10)	0 0½	0 0 6
2 Spare „ „	B	0 0½	0 1 0
1 Note Book 5¼ in. by 3¼	B	0 4	0 1 0
2 „ „	B	0 8	0 2 0
1 Pocket Diary.....	A	0 8	0 1 0
1 Map of Country	A	0 2	
1 Small Writing Pad ..	A	0 2	0 0 6
Seal and Wax	A	0 2	
1 Ransome's Ink Bottle	B	0 4	0 4 0
1 Packet Ink Papers ?	B	0 1	0 0 6
1 Soldier's Pocket Book	B	1 0	0 3 6
Writing & Blott. Paper	B	1 8	
Envelopes and Pens ...	B	0 8	
EXTRA FOR STAFF AND R.E.			
Sketching Case and Cover, or Sabreteche	A		
1 Aneroid (3 in.)	A	0 10	
Ruled Post Paper	A		
India Rubber Pencil ..	A		0 0 0
Colored & Common „	A		
Shading Stump [large]	A	10 0	
3 inch Colour box ...	B		0 7 0
Scale Paper	B		
1 Tin Desk filled, and Canvas Cover	B or C		1 15 0
Abney Level	A or C	0 9	1 13 0
Sextant ..... ?	B	1 0	3 15 0
1 Roller Copying Press	B (0)	1 0	0 6 0
1 Bottle Copying Ink ?	B	0 5	0 3 0
Copying Books	B		0 1 0
MEDICINE.			
8 5-grs. Silvered Pills of Quinine	A		0 3 0
Half oz. bott. of Sulphate of Quinine	B		0 7 6
2 Small Bottles of Chlorodyne.....	A & B		0 1 7
1 Tin Mustard Leaves	A or B		0 1 1
1 Small Bottle of Rhubarb	A or B	1 8	0 0 7
Sticking Plaster, Lint, Bandage, Needles & Thread, Safety Pins	A		?
20 5 grs. Pills of Ipecacuanha	A & B		0 0 8
Insect Powder ..... ?	A	0 4	0 0 9
Carbolic Oil ..... ?	A & B	0 8	
		Totals. lbs. oz.	

SUNDRIES.

No. and Description.	How Carried.	Approx. Weight. lbs. oz.	Approx. Cost. £ s. d.
2 Watches & Keys ...	A	0 12	
2 Spare do. Keys	B		
1 Telescope	A	2 0	2 5 0
1 Prismatic Compass	A	0 9	2 4 0
1 Water Bottle 1½ pints, with Straps [filled]...	A	2 10	0 3 6
1 Pocket Flask „	A	0 8	0 4 6
1 Steel Yard Measure	A	0 1	0 2 0
1 Pocket Lamp	A (3)	0 10	0 7 0
1 Collapsing Cup	A	0 4	0 3 6
1 Comb in Case	A	0 1	0 0 9
1 Haversack, Linen ...	A	0 8	0 0 9
1 „ Mail Cloth ?	A	1 2	0 8 6
1 Knife (Clasp)	A	0 8	
1 Revolver and Case ...	A	2 0	2 0 0
Cartridges for do.	A & B	0 8	
1 Small Towel	A	0 10	
1 Piece Soap.	A	0 1	
1 Tooth Brush and Cap	A	0 2	0 0 9
1 Pair Boot Hooks ... ?	A	0 1	0 1 10
1 Pocket Filter (12) 2½ in. by 1½in.....	A or B	0 8	0 6 0
Spare Tube & Plug for do.	A	0 0½	0 0 4
2 Towels.....	B	2 8	
1 Pair Candlesticks 3in.?	B (8)	0 6	0 2 6
2 Spare Cloak Straps...	B	0 3	0 1 1
1 Large Tin of Wax Matches	B	0 4	0 1 0
1 Ball of String	B	0 2	0 0 4
4 Small Gimlets for Pegs	B	0 4	0 1 0
1 Housewife	B	0 4	0 5 0
1 Holdall, with Scissors, Hair, Tooth, Clothes and Nail Brushes, and Soap Box	A or B	1 2	0 8 5
Case for 3 Candles .	A or B	0 2	0 0 4
1 Small Sponge and Bag	B	0 0	0 1 10
4 Spare Tooth Brushes	B	0 3	0 1 8
2 „ Nail Brushes	B & C	0 2	0 1 0
3 Shoe Brushes (for 3)	B	1 8	0 3 9
1 Water Bottle for Reserve of Brandy ...	B	2 10	0 1 2
Soap	B & C	1 8	0 0 6
Lamp Candles, 12 to a lb., in a Tin	B	2 0	0 2 6
	C	3 0	0 3 0
Useful Papers.....	A, B, C	1 8	0 0 8
6 India Rubber Bands	B	0 2	0 0 3
6 Split Steel Rings ...	B	0 2	0 0 2
4 Tins of Dubbing.....	B	0 8	0 1 2
1 Spare Lamp Glass...	B	0 2	0 0 6
Prayer Book.....			
Passports ..... ?			
		Totals. lbs. oz.	

REMARKS.

Almost everything in this List can be got from the Army and Navy Store, 117, Victoria Street, where arrangements are being made to keep a sample set. A few additional references are given.

(1) White, Aldershot, where also samples can be seen.
(2) Allen, The Strand.
(3) Salsbury, 126, Long Acre.
(4) Scott, 42, Bedford Street.
(5) Intelligence Branch, War Office.
(6) The North British Rubber Co., 4, Cannon Street.
(7) Kopf, 36, Craven Street, Strand.
(8) Barron & Wilson, Strand.
(9) Mordan, 72, Cheapside, E.C.
(10) Richford, 180, Fleet Street, E.C.
(11) Lund, 24, „ „
(12) Silicated Carbon Filter Co., Church Road, Battersea.
(13) Compressed Tea Co., 36, Southwark Street.

Steel articles, such as scabbards, spurs, chains, &c., can be plated with Nickle at small cost: this prevents rust.

Where articles are marked to 2 letters with "or," their weight is assigned to the second letter.

The totals given below do not include clothes actually worn (though the numbers in the lists include those worn), nor arms, telescope, compass, and watch, which are also worn.

T. FRASER.
Capt. R.E.

In addition to Luggage.	A	7 8	All for horse.	A	43 0	Inc. Waterproof.	A	5 6
	B	11 4	Exclusive of Pack Equipage	B	6 2		B	16 2
	C	14 8		C	2 10		C	8 8
	?	11 8		?	19 0		?	11 0

Inc. 2lbs. 7oz. of food.	A	5 0	Exclusive of those for Staff and R.E.	A	2 2		A	6 6
Inc. 11lb. 4oz. of food & 7lbs. for Canteen.	B	19 6		B	4 15		B	12 10
Inc. 18lbs. 8oz. of food.	C	19 11		C	0 0		C	5 2
	?	0 0		?	0 7		?	1 12

GENERAL TOTAL = 191lbs. exc. of horse appts.

A = 26½lbs. and 43lbs. for horse appts.

B = 70½lbs. (Including 11½lbs. of food and 7lbs. for canteen.)

C = 50½lbs. (Including 18lbs. 8ozs. of food & 3lbs. of candles.)

? = 43½lbs. (Including 14lbs. of Camp Equipment.)

J. GALE, PRINTER, OLD BROMPTON, CHATHAM.

PAPER IX.

ARMENIA:

ITS GEOGRAPHY AND POLITICAL FUTURE.

By J. Bryce, Esq., D.C.L.

A Lecture delivered at the R.E. Institute, Chatham, on 11th April, 1878.

Armenia is a curious instance of a name which has continued to be a geographical name for reasons chiefly historical, without having any definite political meaning. There was once a great Armenian kingdom, and a country wholly or mainly inhabited by Armenians, and therefore the name remains, although there is no longer any territory with defined limits, physical, ethnological, or political which it can be used to describe. To Armenia, in the sense we now use the term in, one cannot assign any specified boundaries of race, of language, of religion, of government. We are content to denote by it the territories which formed the Armenian kingdom of antiquity, and again of the earlier middle ages; a territory which is still mainly, though by no means exclusively, inhabited by the ancient and famous race which held that kingdom, and made it, for one or two generations, the kernel of a far more extensive empire. This territory may be said, speaking quite in the rough (for no exact limitation is possible), to extend from Trebizond on the Black Sea to Tavriz in Persia, and from Delijan (fifty miles south of Tiflis) on the north-east, to near Diarbekir upon the upper Tigris, on the south-west. This gives it an extent of some 350 miles one way by 250 the other. Physically, it consists of the upper basins of three great rivers—the Euphrates, the Tigris, and the Aras; and of a smaller tract which drains towards the Euxine by the Tchorok

Su, the Acampsis of the ancients. Politically, it is divided between the empires of Turkey, which includes the greater part; Russia, which holds the north-eastern portion along the Aras; and Persia, which still retains some of the south-eastern districts lying round Urumiah and Tavriz. The name Armenia is as old as Herodotus, and since his time has been that under which the western world has known the country. In the Hebrew Scriptures it is spoken of as Ararat, Minni, Ashkenaz: to the Armenians themselves it is Haisdan.

Physically, with plenty of variety in detail, it has certain leading characteristics which enable one to describe it as a whole. It is a lofty and mountainous land. No part of it, except the strip on the Euxine coast, lies less than 2,300 feet above the sea level, and most of it is very much higher. Some of the table lands, such as that of Erzeroum, rise 5,000 or even 6,000 feet above the sea. Here and there one finds plains—the most considerable are the valley plains along the middle course of the Aras, and the fertile shores of the Lake of Van—but the greater part of the surface is uneven. Of the lofty chains of mountains which traverse it the most important are—that which divides it from Georgia on the north, and culminates in the peak of Ala Göz (13,847 feet); that which runs from the neighbourhood of Erzeroum, where it is connected with the north-eastern ranges of Taurus, eastward as far as Ararat; and that which bounds the valley of the Aras on the north-east, and reaches a height of from 11,000 to 12,000 feet. The loftiest summit in the whole country is Ararat itself (17,000 feet). No other exceeds 14,000, but a good many are above 10,000. These mountains are for the most part (except those along the moist coast of the Euxine), bare, dry, and barren, combining the maximum of height with the minimum of picturesqueness.

This is partly owing to their aridity, but partly also to the elevation of the plateaux from which they rise. Considering their height, they make as little impression as any hills well can do upon the beholder's eye, because he is already placed so high himself. Ararat is an exception: the plain at its foot is only 2,600 feet above the sea, and therefore its magnificent slope of 14,500 feet is fully seen and appreciated. Besides the four river basins I have already mentioned—the Armenians, of course, identify these four rivers with those of the Garden of Eden, the Gihon of Genesis being the Aras, and the Pison the Tchorok Su—there are two remarkable lake basins, basins of lakes which receive streams but do not themselves dis-

charge, getting rid of their water by evaporation. These are the lake of Van, 4,200 feet above sea level, and that of Urumiah, 4,000 feet above sea level. Both are surrounded by high mountains, and in both the water is more or less salt. A third lake, that of Goktcha or Sevan, lies even higher, 6,200 feet above the sea. Its water is fresh, and it discharges by the river Zenga into the Aras and Caspian.

I need hardly say that the geology of Armenia is still very imperfectly known. It has been the theatre of volcanic action on a grand scale, and for long-continued periods. Most of the great mountain masses are volcanic: and in particular the three famous summits of Ala-Göz, Sipan Dagh (on the shore of Lake Van), and Ararat itself, are all extinct volcanoes. None would seem to have burned within historical times; but the existence, not only of hot springs, but of one or more solfataras, sufficiently proves that the subterranean laboratory is still at work. Nor are great earthquakes unfrequent. A particularly violent one, in 1840, shook down a large part of Ararat. These volcanic outbursts have pierced through a great variety of sedimentary strata, ranging from palæozoic down to the latest alluvial deposits of the Aras valley. As might be expected there is considerable mineral wealth in the country, though as yet it has been but little worked. Immense salt mines, at a place called Kulpi, not very far from Kars, supply all Transcaucasia with salt. Copper is worked, of course by an English firm, in Russian Armenia; and coal, iron, silver, have all been found, though whether in quantities sufficient to be of commercial importance has not been sufficiently ascertained.

The climate of Armenia, as you might expect from its geographical position, is a climate of extremes. The country is far removed from oceanic influences, and is also very elevated. The winter cold is, therefore, very severe; the summer, though short, is hot; and the rainfall is very small, not exceeding eight or ten inches in the year over the country as a whole, and in some places sinking to four or five inches. The winter cold, as well as the dryness of the air, is aggravated by the keen north-eastern winds which descend from the frozen wastes to the east and north of the Caspian; and the scantiness of moisture has two remarkable effects. Firstly, it causes the snow line to be unusually high for the latitude. On Ararat it is about 14,000 feet, whereas on parts of the Caucasus, lying further to the north, it is 12,000 or 13,000 feet; and in the Alps, which are only two degrees of latitude north of Ararat, it is on an average,

9,000 feet. A better illustration could scarcely be desired of the doctrine which Dr. Hooker dwelt on so forcibly long ago as respects the Himalaya, that the line of perpetual snow depends more on the humidity of the atmosphere than on the power of the sun. And, secondly, it gives an aridity to the landscape which becomes positively painful to anyone accustomed to the fresh green glories of our European mountains. Few parts of the world, not being absolute deserts, have less wood than the inland regions of Armenia, and suffer more from that want. In north-eastern Armenia, of which alone I speak from personal observation, the only woodland one finds, except along the courses of the streams, is a sort of oak scrub which clothes the slopes (especially the northerly slopes) of the mountains: and sometimes in sheltered glens reaches considerable size.

The soil, especially in the volcanic districts, where beds of ashes or decomposed lava have formed a rich mould, is fertile, and wants nothing but irrigation to enable it to bear noble harvests. Nearly all the crops of temperate and sub-tropical climates can be raised, so great is the variety of climate which the varying height and exposure of the district gives rise to. In the hot valley of the Araxes, where streams drawn from the river enrich the fields, cotton and maize are grown; on the slopes rising from it the vine flourishes and tobacco ripens, while still higher wheat and barley are cultivated on the sides of the hills up to an elevation of eight thousand feet above the sea. The country might support a very large population if good order and security for life and property were established in it, and if there was some capital expended on making roads and constructing or repairing irrigation works. Many of the ancient works—which seem to owe their origin to very remote times—have been allowed, in the political misfortunes of the country, to fall into decay, so that one probably sees Armenia now in a lower condition as respects fertility and general prosperity than it was 1,500 or 1,300 years ago, in the days when its princes alternately leaned on or submitted to the Roman and Persian Empires. Nor is it easy to see how anything more is to be made of it until it falls into the hands of more benevolent, more enterprising, and more capable rulers than those who now divide it between them.

The contrast which its present state presents to that wealth and prosperity which might have been predicted for a region of such admirable natural resources, is due entirely to human causes—to

the repeated devastations it has suffered, to the weakness of the Turkish Government, and to the co-existence in the same area of a variety of different and mutually unfriendly races.

Although Armenia claims to be the first seat of the human race, and the people even undertake to show you the site of the Garden of Eden, this multiplicity of populations is not due to any such remote cause, but to comparatively recent historical events. Lying in the highway from east to west, many peoples have passed through Armenia, and many conquerors held temporary possession of it. Thus, at present, there is presented the strange phenomenon—strange to a western eye, though one speedily grows familiar with it in the East—of men of different blood, tongue, habits, religion, dwelling together in the same towns and valleys, yet never commingling, refusing to intermarry, holding no social intercourse, remaining more distinct than Englishmen are from Frenchmen—who have at least ties of literary or scientific occupations and interests to bind them together. Of these races in Armenia I shall describe to you four—two indigenous, two immigrant—the Armenians themselves, the Kurds, the Turks or Tartars, and the Persians.

The Armenians are no doubt an aboriginal race; at least, however far back we go, we find them settled in the country whence they take their name. So far as I know, that name occurs first in Herodotus, who speaks of them as dwelling on the upper waters of the Euphrates. Their name for themselves is, however, Haikian, and they trace their origin to a mythical ancestor named Haik, whom they make a grandson of Japhet, and a cousin of the progenitor of the Georgians. Their language, which is distantly allied to the Persian, proves them to belong to what is called the Indo-European family, and to the Iranian branch of it. Few races are more easily recognised by their distinctive figure and physiognomy; and this is the more remarkable when one remembers how they have been scattered through the world, and had strangers constantly intruded among them at home. They are mostly of the middle height, rather short than tall, stoutish, and with some tendency to obesity. The hair is black, the complexion usually swarthy, but without the yellowish tint which one notes both in Arabs and (somewhat differently) in Persians. The eyes, too, are black, and have a peculiar liquidity; the nose is almost invariably large, and is, indeed, the feature whereby one can most easily recognize an Armenian among men of other nations. The men are not, take them all in all, a specially handsome race; but the women are,

yielding the palm only to their Georgian neighbours. Not less distinctive is the Armenian character. Although here at home they appear a comparatively quiet and submissive race, cultivating the ground with unwearied industry, and seldom resisting the attacks of the Kurds and the oppressions of the Turkish Governors—they have, indeed, being unarmed, no means of resistance—they show, when transplanted into other countries, an extraordinary degree of enterprise and mental activity. No race developes a greater aptitude for trade: Jews retire before them, and Greeks maintain their ground with difficulty. Although their talents have been displayed chiefly in commerce, they are hardly less conspicuous in other lines of life. They make excellent administrators, soldiers, diplomatists. Under the Byzantine emperors they were distinguished in the military and civil service of the State from the time of Justinian downwards. In Turkey they have long held a leading place as officials; and in the Asiatic provinces of Russia a very large part, and, as one is always told, the most efficient part of the employés is Armenian. More than thirty of them now hold the rank of general in the Russian army.

That there is no lack of fighting qualities in the race is proved by the history of the Armenian tribes of Cilicia. At the time when the Armenian kingdom was overturned by the Seljukian Sultans, in the middle of the eleventh century, the time when the great Turkish descent upon western Asia from the plains of Turkistan took place, under the Sultans Alp Arslan and Malek Shah, a certain number of Armenians who refused to submit to the Turkish rule, quitted their original seats and moved south-west to the mountainous country of Cilicia, at the north-east corner of the Levant; and here some of their tribes have maintained themselves in independence to the present day; small in numbers, but accustomed to the use of arms, and defending themselves in such strong mountain positions, that they have repeatedly repulsed the attacks of vastly superior Turkish forces. In fact, some few thousands of Armenians have made for themselves what we might call a little Montenegro in these Cilician mountains, repeatedly hurling back, even in the present century, the attacks of large and well equipped Turkish armies. I think it need not be doubted, therefore, that the present supposed tameness of the Armenian character is due rather to the unfortunate circumstances under which they live in Old Armenia than to any natural want of spirit and courage.

The total number of Armenians in the world has been estimated

at about 5,000,000. Of these, I should think that nearly 2,000,000 may live in Turkish Armenia, that is in the vilayets of Erzeroum and Van, with parts of those of Diabekir, Trebizond, and Sivas. Over 1,500,000 more are, probably, scattered over the rest of Turkey. There are as many as 200,000 or 300,000 even in Constantinople. About 700,000 or 800,000 inhabit Russian Armenia, and something like 150,000 or 200,000, are to be found in the dominions of Persia. Adding some thousands to be found in the Austrian dominions, in our own, and in Java, this would make something like a grand total of 5,000,000 of Armenians altogether.

The bond which keeps them together is attachment to their national faith and Church. They were the first political body in the world to be converted to Christianity. Before Christianity became the religion of the Roman Empire, at the time when it was embraced by the Emperor Constantine, their apostle St. Gregory, the Illuminator, converted the reigning King of Armenia, a certain Dertad or Tiridates, who was, according to the legend, a cousin of his own, and he and Tiridates soon brought over the whole people to Christianity. The Armenian nation thus claims that as a nation, it was the first Christian state in the world. And it has continued Christian ever since. It separated from the main body of the Christian Church after the council of Chalcedon, whose decrees it refused to accept, and it has never since re-entered the Orthodox Eastern communion. It is not a fanatical or intolerant church, but it entertains very considerable jealousy of the Greek church, and in particular of the Russian church. The Armenians have, it is true, been accustomed to look to Russia for many years past as their protectress, and Russia has, since 1829, included in her territory the famous Monastery of Etchmiadzin, which is the seat of the Armenian Catholicos, or Patriarch, who is the head of the Armenian church throughout the world, and has thereby acquired a certain right and claim to the allegiance of all Armenians. Nevertheless the Armenian people are extremely jealous of the encroachments of the Russian church. They know that the wish of the Russians is, if possible, to absorb their church and to fuse it into the general body of the Greek church. They know that Russia, although she has protected them, has had interested motives in protecting them, and has desired to use them as an instrument, by which she may extend her influence over western Asia; and they naturally regard with great suspicion the attempts which Russia has occasionally, though cautiously, made to interfere with their ecclesiastical system. When the Czar some

twenty or thirty years ago claimed the right of nominating the Armenian patriarch, the Armenian church remonstrated so vehemently that he was forced to abandon that pretension, and although at the meetings of the Armenian council—the national ecclesiastical council—there is present a representative of the Russian government, the patriarch is chosen by the free suffrages of the Armenian church, and claims to exercise his authority quite independently of any commission from the Czar.

The second of the great races that inhabit Armenia, and also an aboriginal race, although far less numerous than the Armenians, is that of which we have all heard so much during the last year, and heard so little good, I mean the Kurds. Now the Kurds, although aborigines, are, in many respects, strongly contrasted with the Armenians. In number they are believed to be less than a million, and they occupy not only Armenia proper, but considerable territories to the south and south east of Armenia proper. And they roam even further over Asia Minor, as far as Sivas, and to the south-west up to Baalbec and the gates of Damascus, where they meet the wandering races of the Arabian Desert. Like the Armenians, they belong, so far as their tongue affords a clue, to the Indo-European race, and to the Iranian branch of it. But their language, which has been greatly corrupted by the infusion of Persian and Arabic words, bears only a very distant relationship to the Armenian.

In person the Kurds are rather short than tall, and singularly well knit and sinewy. More muscular, vigorous frames it is impossible to see anywhere. They are also swarthy, darker in colour, in fact, than the Armenians. They have black hair, but more inclined to be curled or frizzled than that of the Armenians, which is usually straight, and their eyes, although black, are much smaller than and want the liquid depth of the Armenian eye. They have a peculiarly wild, fierce, restless look, which one does not see in the peaceable Armenian. Here in Armenia they are nomads, who live entirely upon the milk and flesh of their flocks and herds, but further south, towards Bagdad, one finds Kurdish villages in the lower ground whose occupants are a comparatively industrious and well-disposed people. During the summer they wander over the higher mountains, living in goat's-hair tents, and in winter they descend, sometimes to occupy rude huts which they build for themselves in the valleys, but more frequently into the villages of the Armenians who inhabit the plains and lower country, and there they quarter themselves on the villagers, and in fact, live upon them, taking whatever

they please to demand. They are nearly all, not merely robbers, but robbers of a peculiarly disagreeable and ferocious kind. To judge from what one hears in these countries of their behaviour (my own scanty experience of them was not unfavourable), it would be difficult to find a race more lost to all the ordinary sentiments of humanity than the nomad Kurds appear to be, for of the settled Kurds in the South I do not profess to speak. They are not only cruel, but wantonly cruel. They are not only robbers, but add, without even the excuse of fanaticism, a malignant tyranny of every kind to the robberies which they perpetrate, and have scarcely a redeeming trait except that chivalric hospitality to their guests which is rarely wanting in warlike races. They are Mahometans, and have sometimes alleged their religious zeal as an excuse for brigandage, but in point of fact they are not at all strict Mahometans; they pay little regard to the precepts of the prophet, either as respects intoxicating liquors, or in other ways. And it may be suspected that their faith is little better than a cloak for the cruelties and oppressions which they practise upon their helpless Christian neighbours.

If any of you have the curiosity to see an account of the way in which they conduct themselves, you will find very full details given in the reports from the British Consuls at Diarbekir and Erzeroum, contained in the two last blue books upon the affairs of Turkey, issued by our Government. Let me refer you particularly to the narrative of a peculiarly terrible massacre which they perpetrated last summer upon the Christians of Vasbouragan, a province lying round the city of Van, a narrative whose solemn and pathetic simplicity makes it more moving than any description I could attempt to give you. It is printed in a blue book issued some weeks ago, in the present year, and is entitled "Letter from an Armenian in Van to a Bishop in Bitlis." Bitlis is a town in Southern Armenia, not far from Van; and this letter is forwarded by our Consul in Erzeroum, who vouches its substantial truth, which indeed is abundantly confirmed from other quarters. What happened was this:—When Russia declared war, the Porte called upon the Kurds to come to its support; and these savage tribes descended from the mountains under the command of their native chiefs, who do not pay any regard to the Government of Turkey at other times, robbing and murdering to their hearts' content, and sometimes attacking even the provincial governors appointed by the Porte. These tribes swooped down from their mountains nominally to act against Russia, but really to

perpetrate as many robberies and murders as they could desire. They fell upon the lowlands of Van, they attacked villages, burnt them to the ground, carried away the women and children, and killed all the men who resisted them. They burnt the crops, rifled or tore down the monasteries and churches, and left the country a wilderness. We heard, some eighteen months ago, more than we like to remember about the horrors that took place in Bulgaria; but I believe that if a narrative were to be written of the cruelties wrought by the Kurds in Central Armenia, its details would be found more heartrending than even those which moved our indignation with regard to Bulgaria. And, be it remembered, there was not in Armenia even the excuse of an attempted insurrection. The Christian population has been perfectly quiet, and was too weak even to have dreamt of a rising.

I said that these Kurds came nominally at the call of the Sultan, but, in point of fact, they care for the Sultan as little, or less perhaps, than we do. They have lived ever since the beginning of history in a state of practical independence. They obey only their own chieftains. They pay no taxes or tribute. They move about the country where they will, very often attacking the Turkish Governors themselves if they venture to interfere to protect the subject population; and, although the Christians suffer most because they are unarmed, the Kurds do not by any means confine their ravages to the Christians. The peaceable Mahometan population of these countries suffers nearly as much from them as do the Christians themselves, and it is as much in the interest of the Mahometans as in the interest of the Christians that one must desire that some efficient force could be brought into play to hold the Kurds in check. And when they came into the war they do not appear to have rendered any service at all to the Turkish armies. So far as can be gathered from the report of our war correspondents and from the facts which I have heard in conversation from members of Sir Arnold Kemball's staff who saw the Armenian campaign, the Kurds were really a hindrance and an obstacle to the operations of the Turkish armies. They ravaged and burned wherever they went, but they never seem to have been able to stand fire or to have given any substantial assistance to the military movements of Ghazi Mouktar Pasha.

Besides these two aboriginal races, the Armenians and the Kurds, there is a considerable mixed population inhabiting Armenia, most of which consists of the people whom we call Turks or Turkomans,

and whom the Russians know as Tartars, people who, no doubt, immigrated into Armenia from the steppes of the Sea of Aral and the Caspian at various times from the seventh down to the eleventh or twelfth century. These people are partly nomads, driving their flocks and herds about the country, but to some extent they have also settled down and begun to cultivate the soil. They speak Turkish—not exactly the language of Constantinople, but a language very similar to it, only a little rougher and less corrupted by Arabic words, and they are all devout Mahometans, far more devout and pious than the Kurds. Those who have settled in villages are industrious and, with some exceptions, peaceable and well-disposed. Occasionally the nomad tribes will be found taking the opportunity to do a little robbery or murder in the way that the Kurds do, but on the whole they are honest, stolid, insouciant, contented folk, who would live in good charity with their Christian neighbours if they were only allowed to do so by their mollahs and imams.

Besides the Turks and Turkomans one finds in the towns a certain number of Persians; only in the towns, however, because the Persians are much more a trading and artizan population than an agricultural one. In the larger cities like Erivan and Van, and in the towns of the lower valley of the Aras, such as Nakhitchevan and Djulfa, you meet a great many Persians most of whom, no doubt, came into that country at the time when it belonged to the Persian empire. It was only in the year 1828 that Russia conquered this last mentioned part of Armenia, which had previously belonged to Persia. At that time, therefore, there was a large Persian population in this valley. A considerable portion of it still remains, and lives in peace and contentment under the sway of the Czar.

The Persians have very little in common with the Turks because they belong to a different sect of Mahometans who entertain a hatred to the Turks more bitter even than that which they feel towards unbelievers. The Shiahs of Persia dislike the Sunni Mahometans a great deal more than they dislike us. And that jealousy has been one of the chief means which has enabled Russia to acquire such influence in Persia, and no doubt does constitute one of the dangers of a Russian advance. Russia has always been able to play off the Shah against the Sultan by availing herself of the religious animosities which exist between the two sects.

Besides the races enumerated, there are a large number of other

tribes of more or less consequence dwelling in the mountains. The most interesting of these are the body called the Nestorians, a Christian sect who have been established here from very early times, and number about 120,000 souls. Although they are Christians, they are quite distinct from the Armenians, belonging to a different church and speaking a different language, which they say represents the old Assyrian. They are different also in character. They are mostly armed, in fact those who inhabit the mountains (for there are also some in the plains) are a sort of warlike clan, able to defend themselves against the attacks of the Kurds and the exactions of the Turkish Government much better than the peaceful Armenians can do. The remarkable fact about all these sects and nations is that although they live side by side, occupying the same country in contiguous villages, sometimes even in different quarters of the same town, they do not mingle or fuse in the least. There is no intermarriage among them, and there are practically no social relations. They never meet except for the purposes of trade. They have no common patriotism. They are all, of course, nominally subjects of the Sultan, but they do not feel, except the Turks proper, any kind of loyalty to him. They are, in fact, so many different nations, distinct in language, in religion, in customs, who merely happen accidentally to be living side by side in the same country. And the difficulty of consolidating these nationalities, and of building up any firm state or government among them is therefore proportionately great.

I need hardly enter into a political disquisition on the state of these regions, and tell you how weak the Government is, how impoverished the country is, how declining its trade and population are; because all that you have read during the last two years about the condition of the Turkish Empire is equally true, and perhaps more true, of Asiatic Turkey than it is of European. The real defect in the government of Asiatic Turkey is not so much that the administration is bad, not so much that the laws are unjust, or even that they are unfairly applied, as that the executive power is so hopelessly weak. The Turkish Government in these eastern provinces has no means to make itself obeyed. It has hardly any army. It has an extremely small police; and the army and police which exist are more or less in the position of an irregular militia which does not necessarily obey the orders which it receives, and it is apt to disperse at the approach of danger, so that it can

never be relied upon to put down an outbreak. It is really far more the weakness of the government than any want of good will on its part that is the cause of the miseries of Asiatic Turkey. The consequence, of course, has been that there is no security for life and property, and where there is no security there can be no prosperity. Nobody, however industrious, has any sort of motive to accumulate wealth when it may be taken from him by the irruption of a mountain tribe. There is no disposition to embark more boldly in trade or to send caravans along a road, when they are liable at any moment to be stopped and plundered by the Kurds. The length to which these outrages may go may be best shown you by a single instance. About sixteen months ago the Kurds and a certain number of Turkish soldiers set fire to a bazaar in the town of Van, which was then the largest and most prosperous of the Armenian cities, and this was done merely for the sake of plundering the shops in the confusion which the fire caused. More than half the town, I believe, was reduced to ashes. The merchants of the place—many of whom were considered pretty wealthy—lost their whole property. The bazaar has not been rebuilt since, and the town in all probability, may not recover itself for many years to come. When a thing like that can happen, and the Government has no power of seizing and punishing the offenders, you may understand what the condition of the country is. And, of course, there is this great further difficulty, that even if peace and order were introduced there is no capital in the country to make roads or to develop its natural resources. It is a country naturally very fertile and might drive a large trade both with Syria to the south-west, and with the Black Sea, if only there were roads and security; but until there comes a firm government and such protection for capital as will induce capital to flow into it, it is impossible even to hope for any improvement.

I now come to a part of the subject which I approach with a great deal of diffidence, because it may seem presumptuous in a civilian to say anything to you about the strategical importance of Armenia. I am merely a private traveller with an interest in history and scenery, and you have been accustomed to consider strategic questions all your lives. I shall not, therefore, venture to do more than simply call your attention to some points which have struck me in reading what has been said about Armenia, from the military point of view, and in comparing the arguments advanced with such facts as I was able to gather on the spot.

We have all heard a great deal said about the strategic importance of this region. We have been told that that the owner of Armenia commands Persia, that he commands the Euphrates Valley, that he threatens not only Syria, but also all Asia Minor and even the Bosphorus, and, in fact, that he occupies an inpregnable position from which he can assail and overrun every part of Western Asia. Now let us see upon what facts or principles this view rests.

First let us consider the case of all Armenia, that is to say let us consider what the results would be if the whole of Armenia—the whole of the country whose limits I indicated at the beginning of these remarks—were to pass under the dominion of Russia; then let us go on to consider what the effect will be, not of so great an annexation as that, but the annexations which, in point of fact, the Preliminary Treaty of San Stefano actually proposes to make.

The first point which occurs to me, and which naturally suggests itself to anyone who travels through the country is this, that if the whole of Armenia were to pass to Russia or to any other great military power it would, unquestionably, give her a very strong miltary position as respects all the surrounding countries. A power which should entrench herself in this mountain land would, in a certain sense, command the banks of the Tigris and Euphrates and Mesopotamia, which lies between those rivers, because in these plains there would be no great natural obstacle to the march of her armies. She would have a very strong position, as towards the open and level area which lies to the south. She would of course take Persia, whose frontier runs parallel with the Tigris, in flank, and she could advance westward from Erzeroum and Diarbekir into the central plateaux of Asia Minor. So far, therefore, there is no denying that the possession of all Armenia would give Russia a military position of considerable value.

There are, however, one or two deductions to be made from that fact. In the first place it would be necessary before that position could be turned to proper account that an immense sum of money should be expended on making roads and bridges, and perhaps also a considerable sum in erecting forts. At the present there is only one road in Armenia that deserves at all to be called a road. That is the great caravan road from Trebizond on the Black Sea through Erzeroum to Tavriz, and it is not a military road according to our idea. It is not such a road as you, gentlemen, would make, but is in most places merely a kind of track something like the mule paths we see in the Alps. It is traversed constantly by caravans, but would,

I suppose, offer great difficulties to the passage of heavy artillery. Russia, therefore, would have to begin by spending a large sum of money in making roads, and what we know of Russian finance is sufficient to show us that she has no money to spare for that purpose. When she had done this she would have a threatening military position. But then, as regards the Persian Gulf, however firm her hold on Armenia, she would still have a vast stretch of country to traverse to reach the sea, and when she got to the sea she would find it occupied by an English fleet. And supposing her to wish to move towards the Suez Canal, she would have a very troublesome country to cross; whether she went inland by the way of the desert, or tried to pass through the mountain region of northern Syria, she would find great difficulties in getting so far south as Palestine and the neighbourhood of Egypt. The same remark applies to a Russian advance along the southern coast of the Black Sea. That coast is everywhere bordered by lofty mountains, and offers great obstacles to the passage of an army. However, these are after all only deductions. I do not mean to deny that the Armenian highlands are a natural fortress of great strength, and, if we look upon the question from the point of view of Turkey, it must be admitted that the possession of the whole of Armenia by Russia would, practically, annihilate Turkish power in Asia. Russia entrenched in that country would cut off Turkey, to a great extent, from her outlying provinces in the south-east, and would in any future war find comparatively little difficulty in overrunning the entire south-eastern dominions of the Sultan. In Mesopotamia (though not in Syria) Turkey would no doubt be practically defenceless. On the other hand it may be said that Turkey is defenceless already. Turkey has already subsided into the position of a protected state, and it is hardly possible, whether Russia should annex the whole of Armenia or not, that she should be able to offer any considerable resistance in Asia to another attack by Russia.

What is of more interest perhaps to us, however, is to consider how Armenia in the hands of Russia would affect our own hold upon India, supposing that Russia should ever attempt to attack us in India. Were she to do so, she would have to advance by one or more of three possible routes. She might advance by the Persian Gulf, moving down from Armenia along the valley of the Tigris. Or she might advance through Persia, moving across the province of Khorassan in the north of that country, or finally she might advance by way of Turkestan and across the Hindoo-Koosh.

As regards the movement by the Persian Gulf, it is obvious that she would have a very long distance to traverse, and that when she reached the Persian Gulf she would find herself confronted and stopped by a fleet. With regard to the route through Persia, the possession of Armenia is not of much consequence, because Russia, commanding the Caspian and able to disembark a force at any point on its southern coast, holds Persia completely under her control already. Persia has lain ever since the year 1828 absolutely at Russia's mercy, and if the latter were to choose to conquer Persia she could do it in the course of a single campaign. Persia has no army to speak of. The country is very poor and very disorganized, and a force of twenty or thirty thousand men would be sufficient to overrun and reduce it, though not, perhaps, to keep order after the conquest was completed. The possession of Armenia is, therefore, indifferent for our present purpose, because if Russia ever desire to attack India by Persia she can just as well do it from her present position as she could if Armenia were already hers.

The third possible route which I have mentioned has, of course, even less to do with Armenia. That is the route by the upper valley of the Oxus, across the passes of the Hindu-Koosh, and through Afghanistan into the Punjaub. You are, no doubt, infinitely better informed than I am as to the mountain barriers which lie in Russia's way upon that route, and which are, admittedly, very great, although the opinions of military men seem to differ as to the extent to which we can rely upon these natural obstacles. That, however, has really no connection with the present question, because the possession of Armenia would not help Russia in the least to attack us by way of Turkistan. If she held the whole country down to Bagdad it could not make the least difference to her advance from the Oxus and over the Hindoo-Koosh.

The general conclusion, therefore, which I think we may gather from a consideration of the ground is this—that, as regards Turkey, it would, no doubt, make the greatest possible difference if Russia were to acquire all Armenia, and so far as our interests are bound up with the maintenance of Turkish power in Asia, those interests would suffer by her acquisition of Armenia; but as regards India, an extension of Russian territory in north-western Asia would not make any difference in a military point of view. What the difference might be as respects what people call *prestige*, it is hard for anyone to say. I do not suppose that any of

us can form a substantially valuable opinion about that point. It may possibly be that the knowledge in India that the Russians held Armenia would make a difference to the loyalty, or rather to the awe, of the Mahometans, and, perhaps, of others also in India. More probably they would know too little about the matter to be substantially affected. However, that question belongs rather to politics than to strategical geography.

Now we come to the acquisitions of Turkish territory which Russia proposes to make by the treaty of San Stefano. She desires to annex all that lies to the north of a line running south-east from a point a little west of Batoum as far as Maku, just beyond Bayazid, on the Persian border. Thus she would annex a strip of territory about 100 miles long, and from 30 to 80 miles wide. I cannot say (speaking necessarily with diffidence on such a matter) that it appears to me, as far as one can judge from looking at the country on the spot, that this increase of territory would make any very great alteration in the strength of her strategic line; for a glance at the map will show you that the proposed annexations do not bring her nearly to the south of the mountain country. There will remain several high wild and bare chains of mountains still lying between her and the plains of Mesopotamia, chains which she would have to cross if she were to try to move either upon Bagdad and the Persian Gulf, or in the direction of Syria. These intended annexations will not, though they certainly bring her nearer to Erzeroum, substantially improve her strategic position for attack towards the south and south-west. There is a belt of mountain land, from 60 to 100 miles wide, intervening between her proposed new frontier and the place where the mountains begin to subside into the plains in the direction of Mesopotamia and Syria. That mountain country, which is very difficult, and easily defensible, her invading armies would have to cross; and it may therefore be concluded that she has not materially lessened the difficulties which a movement upon Syria would imply, owing to the nature of the country and the great distances to be traversed. At the same time let me remark that as the caravan route to Persia from the Black Sea passes through Bayazid, the possession by Russia of that town and the valley in which it lies would enable her to stop that trade by her custom houses, and that it would be decidedly better for Turkey if the new frontier line were drawn more to the north than as now proposed by Russia, so as to leave the strong positions of the Soghanli Dagh, near Zewin,

still in Turkish hands. As regards Batoum, about which so much has been said, it is just worth while to remark that it is not in any sense either a military or a naval stronghold. People talk about it as if it were a kind of possible, if not actual, Portsmouth or Sevastopol. In reality, it is a bay, more like that of Dover than it is to Sevastopol—a small open bay, with high ground behind, upon which, no doubt, forts might be thrown up and batteries constructed; but it is not a deep and secure inlet, with creeks and ports where a navy could lie. It is rather an open bay, formed by a long sandy spit, which has got very tolerable anchorage; but it is exposed to the violent northerly winds which sweep these seas, and therefore no large vessel can lie in it with safety when the wind blows from the north. The trading steamers which ply along that coast are obliged to get up steam and run out to sea as soon as the wind rises; and I cannot think, therefore, that Russia, in possession of Batoum, would be able to create a naval stronghold which would cause any apprehension to us, or which would practically strengthen whatever hold she has of the Black Sea. Still less does Batoum command any land route. Behind it lies a wild mountain country, and between it and Trebizond are the lofty mountains of Lazistan, breaking abruptly down to a deep sea, and inhabited by warlike Mahometan tribes. Its possession would not substantially improve Russia's military position. The reasons for which she desires it are purely commercial. She has at present no port on the Black Sea which can serve as an outlet to the trade of her Transcaucasian provinces. Batoum would supply this want. Its possession would therefore be a substantial benefit to those provinces, while it would be no real injury to Turkey, inasmuch as Turkey does not at present make any use of the port of Batoum. Such trade as there is into these provinces of Turkey enters at Trebizond, and from Trebizond passes along the caravan route to Erzeroum and Bayazid. This trade would remain unaffected by the cession of Batoum, which is now little more than a place where the Russian trading vessels lie and tranship their goods when the weather is too rough for them to approach Poti, the terminus of the Russian Transcaucasian Railway.

Before I conclude let me say a word or two on the possible political future of these countries. Turkey, as an independent state, is obviously dying; and the question arises, what will happen when Turkey is dead? Who is to replace Turkey? If she is no longer able to hold her own against Russia, and to secure peace and order in these countries, what can be put in her stead? People

talk of turning the Turks out of Europe into Asia, as if that would set things right; but the truth is that the Turks are just as bad in Asia as they are in Europe; and there seems, as far as one can judge, to be quite as much reason for keeping up their power in Europe as there is for keeping it up in Asia. In Asia, as well in Europe, they are now hopelessly weak, and practically unable to maintain themselves either against foreign enemies or domestic rebels; and if they are to live, they must live by the protection of the European powers. The question, therefore, is fairly posed, what is to be done with these countries in the future, and to what kind of constitution or government for them are we to look forward?

Now, there are only three alternatives which we can contemplate as possible for these countries. The first is that they should be annexed, or taken over, by some of the great European powers, and, of course, the most natural power to take them over is Russia. Well, we all, I suppose, whatever our political sentiments may be, heartily agree in deprecating and desiring to oppose any extension of Russian power in that quarter. We all agree that Russia has got quite enough territory. We think that she ought to know that herself; and we are unwilling to contemplate any state of things which would give her a larger slice of Asia than she has got. That possibility, therefore, as far as our power and wishes go, is out of the question. Then, is there any chance that we should ourselves undertake the protectorate of Syria or of Asia Minor, or that France should do so? This also we must answer in the negative. We have enough to do elsewhere, and France has enough to do at home, without undertaking such tremendous responsibilities.

Well, then, can any Eastern race be looked to to fill the void which the fall of the Sultanate will cause? Formerly in these countries when one race became effete, some new race came down and seized the sceptre, and set up a stronger government, which lasted for a century or two. That is now impossible, because the reservoir of nations which existed in northern or western Asia is dried up. There are no new Oriental races on the horizon out of which conquerors and rulers can arise.

The third alternative which seems to remain is the creation out of materials existing on the spot of some new native state, either of a Mahometan or Christian nationality. There seems, unfortunately, to be very little prospect of any Mahometan race organizing a kingdom in those countries. None of the races has sufficient intelligence

or sufficient capability for civilization and progress to erect a stable monarchy on the ruins of decaying Turkey. The Arabs and the Persians ruled great and flourshing empires in ancient times; and some might wish that such empires were rising now, detestably as they administered their territories. But of such a development there seems to be no hope or prospect.

We are, therefore, thrown back to consider whether there is any Christian race which can possibly arise to take the place of the Turkish Government. Now the only race in the east which seems to show any power of development and progress is the Armenian. I am, perhaps, disposed to over-value the Armenians, having conceived a certain interest in their country and themselves from having visited the place myself, and dipped into their history; and I do not wish, therefore, to advocate the cause of the Armenians, or insist upon their merits as if it were possible to feel sanguine or confident with regard to their future. There are many points of weakness observable in their condition, and which may raise doubts as to their power to rise to the great mission which seems to lie before them. First of all comes the great difficulty, that there are not quite enough of them. There are unfortunately only some three-and-a-half or four millions of Armenians altogether in the Turkish empire, and some may think that that is too small a nucleus for any state. Except in the district just about the city of Van they are nowhere, perhaps, in an absolute majority of the population, although in many districts more numerous than any other one race. In some parts even of Armenia proper, the Mahometan population seems to outnumber them, and those who inhabit Old Armenia are undoubtedly at present an unwarlike and almost too peaceable a people; centuries of tyranny and submission have told upon their spirit, and one cannot look forward to their rising in arms to defend themselves, or asserting their rights in the presence of their enemies, as was done for instance by the Greeks in the beginning of the present century. On the other hand they are an intelligent and enterprising people. They are an eminently industrious people. They are a people who have of late years done a great deal to educate themselves and improve their own state, and they have a strong and growing feeling of nationality. Their attachment to their church, which rises I might almost say to a passion, gives them a unity and a cohesiveness which is wanting in any of the other races of these countries.

If peace and order were once secured in the regions they inhabit, their numbers would quickly increase, not only by the natural growth

of population, which is unusually rapid among them, but also by the emigration which would take place from other parts of Turkey and from Persia into Old Armenia. Thus they might become able in course of time to be formed into and support an independent, or semi-independent, principality. This is a prospect not for the immediate but for the more distant future; I only suggest it to you as being probably the best prospect that offers for the ultimate well-being of these countries. It seems, so far as one can see at present, to be the only alternative to a further advance by the Russian power; and it would certainly constitute the best check that could be opposed to a Russian advance, because if you had an Armenian nation and an Armenian principality, you would have a powerful national sentiment evoked against the ambition of Russia. The Armenians would, so to speak, stand sentinel upon the borders of the Russian and Turkish empires, ready to resist any further aggressions on the part of Russia, unwilling to be absorbed by her, and rather desiring to become ultimately an independent state, claiming a place among the kingdoms of the world, and taking for its task the civilization of the inland regions of Western Asia, as the Greeks would take the seaboard. At the same time there would be removed the pretext which Russia at present has, and has long had, for advancing towards the South.

So long as the government of Turkey remains weak—so long as anarchy continues in these Asiatic provinces of hers, so long will there be discontent among the Christian population, appeals to Russia, intrigues by Russian consuls and Russian agents, outrages and oppressions, furnishing a ground for Russian interference. The removal of such pretexts, which have never been wanting in the past, would be the best and firmest barrier which we could raise up against further Russian aggression. In time—not, perhaps, in our time, but in the course of two or three generations—if peace were once secured, an Armenian province might well grow into an Armenian state; and the Armenian race, which certainly shows far greater capabilities than any other race in these countries, might become the means of spreading civilization and commerce through these neglected regions. I do not venture to put this forward as more than a hope; but, such as it is, the hope, the possibility, is at any rate worth our considering. Even a more slender hope, even a slighter possibility, would be enough to make us wish that England, whose aims are pure, who has always sympathized with freedom, should not refuse this opportunity of serving both the

world and herself, of erecting a barrier against the aggressions of Russia, of giving freedom to these long down trodden populations, and of restoring peace and prosperity to countries which were the first homes of civilized mankind.

J. B.

PAPER X.

REMINISCENCES OF THE

CAMPAIGN IN ARMENIA.

By Captain H. Trotter, R.E.

A Lecture delivered at the R.E. Institute, Chatham.

It was with much pleasure that I accepted the kind invitation of Sir John Stokes to give a short account to my brother officers of some of the recent military operations in Armenia. Early in May last I was appointed Military Attaché to Her Majesty's Embassy at Constantinople; on arrival there I was at once sent to the seat of war in Asia, and placed under the orders of Lieut.-General Sir Arnold Kemball, who had been sent to the front for the purpose of watching and reporting on the Asiatic Campaign. I landed at Trebizond on the 24th May, 1877, exactly one month after the declaration of war, and at once hurried on to Erzeroum to join my Chief who had preceded me by about a fortnight. The distance was close upon two hundred miles, and had to be performed on horseback. Under ordinary circumstances fresh post horses are obtainable at distances of from 20 to 30 miles apart, and the journey can easily be got through in three days, but owing to the unusual number of travellers who had recently passed along the road, the post horses were utterly worn out, and rarely, if ever, could they be moved out of a walk, so it was only by travelling all through the day and half through the night that I was able to reach Erzeroum on the 5th day. The road was constructed some years ago by the Turkish government at an enormous expense; it is bridged and metalled throughout, but the large amount of traffic that had recently passed over it made it extremely heavy in places. The scenery for the first few stages is extremely picturesque; the road leads along hill sides covered with rhododendrons and azaleas, with oak, beech, and birch. The hills in the neighbourhood of the first pass are covered with pine and larch, reminding one much of Kulu, one of the most beautiful of Himalayan valleys; my spirits rose as

I thought of the pleasure of campaigning amongst such charming scenery, and I then little thought that I should shortly be encamped for months on bare, arid, stony plains, without a green leaf, or blade of grass within several miles of me. This fine and agreeable scenery did not last for long; as we descended into the Gumush Khana valley, the hill sides became bare and stony, although some of the lowest valleys contained cultivated patches, with cottages prettily situated in orchards. These cottages, however picturesque to look at, soon lost all romance on closer acquaintance. My travelling companion and guide was the Persian courier who carries the mails between Erzeroum and Teheran, and the lodging houses which he selected for my accomodation, and which he asserted were the only ones to be had, generally consisted of one large room, inhabited by cattle, horses, and fleas innumerable; the portion specially set apart for fleas and men consisting of a boarded corner a few feet square, and raised a few inches above the floor of the stable. Of course in the large villages there was better accomodation, but I do not believe there is a house or room in Armenia free from the plague of fleas, and I always esteemed myself fortunate if I encountered nothing worse; and although the neighing and shrieking of horses in one's immediate vicinity were not conducive to sound sleep, yet the animals kept the chamber warm, a not unimportant consideration on the bitter cold nights which we experienced even in June, when snow still lay on the higher parts of our road.

Signs of war were encountered all along the route, and not a day passed that I did not come across heavy guns and ammunition, and stores going along to the front; some forty heavy siege guns intended for Erzeroum, as well as thirty field pieces were passed *en route*, and the most strenuous efforts were being made to bring them up to the front. At Gumush Khara these heavy pieces (15 centimetre) were being dragged in triumph up the steep road by crowds of men and boys, urged on by their priests and schoolmasters, amidst the cheers of the bystanders. Arrangements were made where villages were plentiful for having the guns dragged on by relays of men; further on where the population was more scant, teams of bullocks replaced human labour, at other times long trains of camels were passed, each animal having a couple of awkward shaped packages slung across its back, containing ten Martini-Henri rifles, or the same number of Winchester carbines, in cases fresh from the manufacturer in America. Bullocks innumerable, and ponies were

trudging along, each with a pair of ammunition boxes; carts also ploughed through the heavy ground laden with tents and other stores.

Soldiers too there were marching up to the front at the rate of 20 miles a day, straggling along as the Turkish soldier generally does, in no sort of order, one battalion perhaps covering a couple of miles of road. Many of the smaller villages along the road were deserted, the Greek christian inhabitants having retired with their cattle into the surrounding hills, to avoid too close contact with the hungry Turkish soldiery going along the road. I may, however, state once for all, that I rarely, if ever, heard complaints in any parts of the country of misbehaviour on the part of the Turkish regular soldiers, who I must state are the soberest, quietest, most long-suffering class of men it has ever been my lot to come across in any part of the world. With the irregulars, however, it is very different, and I never in any part of the country followed in the wake of Circassian or Kurdish soldiery, but I was deluged with only too well founded complaints about their misconduct. Although these worthies, especially the Kurds, from their behaviour in the field appear to set a high value on their own lives, they certainly have very little respect for other people's, and numerous authenticated instances came under my notice in the course of the campaign, where the life of some unfortunate villager was taken because he would too vigourously remonstrate against being forcibly compelled to provide food and fodder for his uninvited guests. It is no wonder then that in many cases we found the villages empty, and that we ourselves had considerable difficulty in providing ourselves with the necessaries of life as we advanced.

I must, however, hurry on to Erzeroum, where I was most anxious to arrive before the Russians, who according to report were in full march for that place.

It is now time to take a general glance at the country, where operations had been and were about to be carried on, and to state roughly the positions of the contending forces at the time of my arrival. The short account I shall give will probably be superfluous for the greater part of my audience, but is necessary for the benefit of those who have not carefully followed out the events of the campaign.

Erzeroum is the chief town of Armenia, and is a flourishing and prosperous city, with a population of some 40,000 souls. It is the head-quarters of one of the seven Army Corps into which the Turkish

Army is divided, is connected with the sea coast by the capital road along which I had been travelling, and has also other roads going off in every direction into the interior, one of the most important of which is that to Bayazid and Northern Persia, a well known trade route along which British merchandize to the value of three-fourths of a million pounds sterling is annually carried into Persia. Erzeroum then was naturally the objective point which the Russians were anxious to get possession of. It is distant about 150 miles, as the crow flies, from the Russian frontier at Alexandropol. This Russo-Turkish boundary extends from the mouth of the Cholok river, north of Batoum, to the lesser Ararat, a distance of about 250 miles. There are three main roads by which Erzeroum may be approached from the Russian side; the first on the North from Akhalzig and Akhalkalak, by Ardahan, Pennek and Olti; the second from Alexandropol or Gumri, *viâ* Kars and the Soghanli mountains; and the third from Erivan by Bayazid and the Alishgird plain. These two last roads meet at Kuprukui, 30 miles to the east of Erzeroum. The country over which these roads pass may be described as a region of high plateaux of an elevation of from 5,000 to 7,000 feet above sea level, intersected by a complex system of lofty mountain chains rising to 12,000 or 13,000 feet. The roads are few and bad, especially in the spring during the melting of the snow, and after heavy rains, when they in places become almost impassable for carts or guns. The shortest and most practicable of these three lines of approach is that by Kars, and as there are several alternative routes over the Soghanli mountains, this in previous wars has always been the principal line of advance. Now what obstacles had the Turks to oppose to the Russians on these three lines? On the Northern road the strongly fortified fort of Ardahan, with a garrison of some 8,000 men, and ninety guns in position; on the centre line Kars, with a garrison of 20,000 men all told, and at least 300 guns of position; and on the South at Bayazid a small force of 1000 men at the outside. Mukhtar Pasha, who had only very recently taken over command of the 4th Army Corps, was in the neighbourhood of Kars, in command of a flying column of eight battalions (*i.e.*, about 5,000 men), and he had, in addition perhaps, thirty battalions or 15,000 men in the neighbourhood of Erzeroum, and scattered about at various points on the three roads between Erzeroum and the Russian frontier; other troops were being rapidly collected from various parts of the country. The Russian invading force was estimated, and believed by the Turks to amount to at least 100,000

men, and it was not till July that the Turkish Commander became aware that the Russian invading force in front of Ardahan, Kars and Bayazid probably never exceeded 60,000 men.

I have hitherto made no mention of Batoum, where in addition to the figures given above, a force of some 15,000 Turks under Hassan Pasha were opposed by about an equal number of Russians under General Oklobjio. The operations at Batoum were quite independent and had no influence on the operations undertaken for the capture and defence of Erzeroum.

The campaign opened most disastrously for the Turks. War was declared on the 24th of April, and on the same day the Russians crossed the frontier, their right near Batoum, their centre near Alexandropol, while their left started from Erivan for Bayazid. Intelligence of the declaration of war had not reached the Turkish army, and the first information that their cavalry outposts on the Arpa river had of the outbreak of hostilities was finding themselves surrounded and prisoners; while one Russian column advanced by Alexandropol upon Kars, another advanced from Akhalzig to Digwir, threatening both Batoum and Ardahan, to the latter of which places it was really directed, and in front of which it effected a junction with a portion of the Alexandropol army. The two forces amounted to some 18,000 men, and on the 17th May Ardahan fell after a feeble resistance, giving the Russians free communication with Kars and laying open the route through Olti to Erzeroum. Meanwhile, Kars had been surrounded, and Mukhtar Pasha at the head of his column of eight battalions had retired precipitately to the Soghanli Dagh. The Russians made excellent use of their enormous body of cavalry, a force in which the Turks were lamentably deficient, and had been able to send a strong column under General Loris Melikoff, to assist in the capture of Ardahan, without the Turkish garrison at Kars having any idea that the Russian force in front was materially weakened; meanwhile the Russian left, under Tergukasoff, reached Bayazid on the 30th April. As soon as their advanced guard came in sight, the small Turkish garrison rapidly retreated in the direction of Van, abandoning a considerable quantity of stores which they had no means of carrying away and apparently no time to destroy.

This then was all I could learn on my arrival at Erzeroum on the 29th May. Turks and Russians were facing each other in about equal strength at Batoum; Ardahan had fallen eleven days previously, and Bayazid had been in the hands of the Russians for a

month; Kars with its garrison of 20,000 men was surrounded by a Russian force almost double its strength, and apparently well authenticated rumours of its fall had already reached Erzeroum. The position was by no means hopeful—apparently desperate, and I think there can now be no doubt that had the Russians boldly pushed forward after the fall of Ardahan, Erzeroum would have fallen without a struggle, and I know as a fact that Mukhtar Pasha was at one time quite prepared for that eventuality.

I will now revert to my own experiences: as the Russians were said to be advancing from Ardahan to Olti, where a Turkish force was stationed, Sir Arnold determined to go out in that direction, and we started in company on the last day of May. We were in very light marching order, no tents, nothing but a change of clothing and a few eatables, and an escort of half-a-dozen mounted police. Our first day's march was to Hindsch, 12 miles, a village situated in a valley, down which flows one of the affluents of the Western Euphrates, our second march was to Kutumar, 29 miles further on. Three miles beyond Hindsch we passed a Turkish force of three battalions encamped across the valley, in rear of some injudiciously placed and badly constructed earthworks of very feeble profile. Further on we met several groups of fugitives from Ardahan, and got several interesting particulars from them about the fate of the place.

Towards the close of this second day's march we met four battalions of Turks retiring from Olti, to which place we were to have marched the following day, but as it was denuded of Turks it was not unlikely that we should have met the Russians, who were reported to be in full march on Erzeroum, and who, in fact, did occupy Olti two or three days later on with a force of some 2,500 men, sending a small cavalry force as far on as Nariman.

To avoid the Russians we struck across the mountains by a bridle path, and after two days march of 29½ miles and 25 miles respectively, we reached Khorassan on the Kars-Erzeroum road. Our path, after going up steep spurs, and passing occasional small villages, lay across the Herman Duz, an extensive grassy plateau about 9,000 feet above sea level, and partially covered with snow. On entering the Araxes valley we again encountered troops retiring from the front; this time it was Circassians, a few wounded men being carried on horseback into Erzeroum, escorted by at least treble their number of comrades who seemed even thus early in the campaign to have had as much fighting as they cared about. It appears that Mukhtar

Pasha while encamped at Tchakir Baba had allowed his Circassians, some 1500 in number, to go down to the Kars plain and try their luck against the Russian cavalry; they were suprised at night in the village of Begli Ahmed, 18 miles south-west of Kars, by a superior force of Russians, but succeeded in cutting their way through, leaving some 50 of their number dead on the ground, and losing two small mountain guns. This was the first recontre I had with the Circassians, and I was favourably impressed with their appearance; they were fine, handsome, intelligent men, but badly mounted; unfortunately they have no leaders whom they can trust. After we had gone a little way on our road some of these Circassians turned and came after us, and addressing Sir Arnold Kemball said, that if he would promise to lead them they would immediately return with him and follow him through thick and thin, and so undoubtedly they would have, but our position as neutrals forbade us trying any such experiment. We learned on arrival at Khorassan that Mukhtar Pasha had fallen back from Tchakir Baba and Yenikui to Zewin, and that the Russian centre had advanced their outposts to Sara Kamysh. At Khorassan itself we found two battalions and two mountain guns that had fallen back from Gulentab, a day's march further down the Araxes. The troops on the Bayazid road were also reported to be falling back on Delibaba; in fact, we had ocular demonstration that the whole of the Turkish forces were rapidly retreating on Erzeroum. At Khorassan we found a comfortable lodging, and halted a couple of days to rest our horses, which were showing decided signs of fatigue. On the 6th June, I rode over with Sir Arnold to Zewin Duz, about 14 miles distant, the head-quarters of Mukhtar Pasha, whose acquaintance I then made for the first time; I was favourably impressed. He is a good looking and pleasant featured man, somewhat below middle height; he received us with great courtesy. I was much surprised at the small amount of state and show; we found him in a small bell tent, whose only furniture consisted of a camp bed and two stools, one for the Commander-in-Chief and one for Faizi Pasha, the chief of his staff, a gallant old Hungarian officer who had been chief of the staff to Sir Fenwick Williams in the defence of Kars in 1854. The tent was green and pitched on a little knoll, with two branches of pine stuck in the ground in front; a couple of sentries before the tent were the only signs of the rank of the owner. He gave us a very substantial breakfast, *á la Turque*, *i.e.*, a large round tray was placed on an empty ammunition

box, and we all gathered round it; soup was put on the table in a large bowl from which we all helped ourselves direct, being provided with spoons but no plates; the soup was followed by a succession of three or four other dishes, not bad in their way, and we helped ourselves therefrom with our fingers.

After breakfast we went round the position; the road from Khorassan passes over low undulating hills until it reaches a range much more steep and precipitous. It was here that Mukhtar had taken up his position, his troops being encamped behind two parallel ridges; the front or first line overlooked a deep valley in front, across which, through the mountains, was visible the road from Kars; on the extreme right of the front ridge was a rising knoll on which four Krupp guns were in position, commanding the roads in front, naturally so strongly placed that, as I then thought and wrote, this part of the position was impregnable. The second line was about one-third of a mile in rear of, and parallel to the first, and was a very strong natural position, with a gentle slope in front and a steep incline in rear. Along the two lines were disposed 18 battalions, 12 field and 12 mountain guns. Shelter trenches of very slight profile had been constructed along the whole length of both lines, with just sufficient cover for a person to crouch down behind. There were two peculiarities about these trenches that attracted my attention, and of which I asked Faizi Pasha, who had designed them, for an explanation: 1st, the earth taken from the excavations was thrown behind instead of as is usual in front of it; and, 2nd, the trenches were constructed some few yards in front of the crest of the hill, instead of being on the crest. The reason given for the first was, I think, a good one; it was that owing to the very hard and stony nature of the soil, the earth *in situ* was a better protection than when disentegrated and loose; as it was, bullets striking in front, where the crest formed a natural glacis, would very likely bound over the heads of the men in the trenches. With reference to the second point his explanation was peculiar, to say the least of it, he said that all the troops were very raw and had never seen any service, and that by placing the trenches in front of the crest of the hill, the men would, when under the enemy's fire, be compelled to remain in the trenches from the knowledge that they would dangerously expose themselves were they to attempt to retire. It would appear from this, what certainly was the case, that at this period of the campaign the superior officers had no confidence in their men, who, however, deserved a better

opinion, for within three weeks of my visit, the Russian centre column, 17,000 strong, hurled themselves impetuously time after time aganst these very intrenchments, and were repulsed with tremendous slaughter.

It is, however, only fair to say that in the interval the Turkish soldiers had been incessantly drilled and exercised, and much credit was due to Mukhtar for the manner in which the once raw and untrained soldiery were made fit to meet and repulse the more highly trained troops of the Czar.

But I am anticipating. In course of conversation with Mukhtar we learned that the Russian centre and left had halted in their advance, and that the centre appeared to be fully occupied with the siege of Kars, where almost daily fighting was said to be going on, although communication with the fortress was cut off. It appeared a favourable moment to try an offensive movement against the Russian detachment occupying Olti, reported to consist of 1200 infantry and the same number of cavalry, with six mountain guns.

Prior to the Russian occupation, Olti had been held by nine battalions, and on the enemy's advance these troops had, under orders from Mukhtar, fallen back; four battalions, whom it will be recollected we met on our road out to Olti, retired to the Giurgeh Boghaz, and five battalions went southwards to Mukhtar's camp at Zewin.

Mukhtar now thought he would catch the enemy in a trap, and he advanced two columns, one from Giurgeh Boghaz to attack them in front, and another column from Zewin to attack them in a defile as they retreated. The total strength of the two columns amounting to 11 battalions.

I obtained permission from Sir Arnold to follow the force from Zewin, so I returned that same evening to Khorassan to get my traps, and found there my colleague Captain McCalmont, 7th Hussars, just arrived from England.

In honour of his arrival we had a little excitement—a false alarm of a Russian attack. Skirmishers were thrown out just about sunset and several shots fired, but all ended in smoke.

Next morning Captain McCalmont and I started for Olti, paying another visit to the Mushir *en route*. Our party consisted, besides ourselves, of one servant, one groom, and one baggage pony, *i.e.*, we were four men with five horses, besides a guard of two Zaptiehs, or mounted policemen. We got over 30 miles before dark, crossing the Top Dagh by a pass 9,500 feet high. It was a glorious day, and the ride beyond the pass was through some of the prettiest scenery I

have ever seen, a most wonderful combination of fresh green meadow land lying between bold fantastic rocks, plentifully covered with Scotch firs; snow was lying about in patches, and the colouring of the distant ridges as we looked down the valley towards the setting sun produced an effect which I have never seen surpassed. At an elevation of 9,000 feet our road lay over rich grassy slopes, and the perfect stillness that prevailed around formed a pleasing contrast to the scenes we expected ere long to be called on to witness. This time, however, we were to be disappointed in our expectation of a fight. Pushing on the next day as rapidly as we could, we struck the Olti valley at Id, 13 miles above Olti, and there learned that the enemy, thinking discretion the better part of valour, had hastily evacuated Olti and retired towards Ardahan. We pushed on and arrived at Olti the same evening, and found there the whole of the cavalry force that had been sent by Mukhtar for the annihilation of the Russians, and a motley crew they were, two regiments of Bashi Bazouks and one of Circassians; they were armed and clothed in a very miscellaneous manner, mostly with spears and pistols, some few with guns and rifles; awful looking ruffians most of them were. Their leader, Shahin Pasha, accosted me in excellent French, and learning who I was sent an escort with me to Hadji Redschid Pasha, commanding the field force, who I found was expecting our arrival and had made everything comfortable for our reception in a capital house, where he provided us with a guard of honour.

Hoping to see something of the Russians, we prevailed on the Pasha, with some difficulty, to let us visit the next day his cavalry outpost at Pennek, 15 miles beyond Olti, at the junction of two roads from Kars and Ardahan. We went there accompanied by a strong cavalry escort, but the Russians had made a clear track and were supposed to have gone to Ardahan. Returning to Olti we found, five miles to the north, two Turkish battalions lining some perfectly bare stony hills, which nearly block up the valley. As the troops had no tents and the sun was very powerful, they had protected themselves from its rays by shades made of branches of trees, obtained from the orchards in the Olti valley. We were made heartily welcome, and invited to take a cup of coffee and the universal cigarette by the commanding officer, a gallant little fellow, who was full of life and full of abuse of Mukhtar Pasha, for having originally abandoned Olti without a struggle. Poor fellow, some months later I saw his mangled corpse being carried off the battle field near Bayazid, struck close by me by a shrapnel bullet.

I was much pleased with what I saw of the troops at Olti. They were much elated at the success of their bloodless victory, and for the first time since my arrival in the country I began to think that Erzeroum might yet be saved.

After waiting some days at Olti, and finding that there was no sign of any further movement on the part of the Russians, McCalmont and myself decided to return to Zewin, where we thought we might see some fighting. We reached it at noon on the 16th, interviewed Mukhtar, who told us that if we wanted to see a battle now was the time, as he was reinforcing his right wing, and had ordered an attack on the Russian left, which he thought would come off in one or two days time. Without staying to hear any more we hurried on to Khorassan, where we lunched, and at about 4 o'clock in the afternoon were just starting for Delibaba, when we saw two horsemen rapidly approaching from the ford over the Araxes. These were Sir Arnold Kemball, and Captain Norman, the *Times* correspondent, who had just ridden in five and twenty miles from the battle field of Tahir, where the Russians instead of waiting to be attacked had themselves assumed the offensive and gained a signal and complete victory over the Turkish right under Mahomed Pasha, who had been killed by a shell at noon that day, and whose fall was the signal for a universal retreat. It was no good my going on, but I returned at once with Sir Arnold's permission to Mukhtar Pasha. I reached his camp at midnight and found that he had learned the bad news by telegraph, in fact I met on the road the whole of his cavalry force going down to the ford at Khorassan. He was in his telegraph hut when I arrived, and he remained there till 5 o'clock the next morning, communicating with Mustapha Pasha, who had succeeded to the command and was rallying the broken forces at Delibaba and Tai Khoja. Now it was that Mukhtar's genius and pluck came to the front. Instead of ordering a general retreat, which many thought was his only chance of saving his army, he telegraphed to Mustapha to hold his position at Delibaba at all hazards, and that he would soon send him further assistance; nearly his whole cavalry force he had already sent. He could not afford however to weaken his centre, as he had intelligence that the Russians were also advancing from Kars, and he had not one man too many for the defence of his position at Zewin. He telegraphed however to Erzeroum, to have every available man sent to the front. He telegraphed to Olti, to have eight battalions out of the eleven that were there, instantly sent off to join him at Zewin;

these men marched in on the afternoon of the 19th, three days after the battle had taken place; and within an hour of their reaching Zewin five fresh battalions were started off to reinforce the right. This time Mukhtar wisely kept his counsels to himself. Not a soul in camp (except the chief of his staff) knew what were his plans. When I saw the troops moving out of camp I went to him to try and get a hint of his intentions. I told him I wanted to see the fighting if any there were to be, so he counselled me to go on to the top of the highest mountain I could find, and perhaps, I might see what I wanted. At last, however, he gave me the more practical advice to go down to Khorassan that evening—sleep there, and ask in the morning for news. We took the hint and started. Unfortunately, our servant was taken very ill on the road, and we did not get in till late at night, and had to go supperless to bed. In the morning early I asked the news, and I was told to my astonishment that Mukhtar and his staff, to whom I had bidden a solemn farewell only a few hours before, had arrived there at midnight, spent two hours in the telegraph office, and then pushed on towards Delibaba. You may imagine we lost no time in saddling and mounting, and pushing on to overtake him—we did this about 9 a.m. on the morning of the 20th, passing *en route* the battalions that had left Zewin the previous afternoon. We found Mukhtar making preparations for a general advance. It was a very beautiful sight, the troops gradually wended their way down from the heights commanding the entrance to the Delibaba defile, cheering lustily, for it was now generally known that the Mushir himself had arrived, and that the lengthened period of inaction had at last come to a close. The army, 19 battalions strong, advanced in three columns, one on each side of the Delibaba pass, crowning the hills, or rather mountains, which formed the defile along which the centre column, which was accompanied by two batteries of artillery, wended its way. Our mountain guns, ten in number, accompanied the columns on right and left. Our advance was very slow, as there was the possibility of our coming at any moment in contact with the enemy, who was in unknown force somewhere in front of us, and the country had to be carefully reconnoitred by cavalry before the infantry and artillery could be advanced, otherwise, we might suddenly have found ourselves caught in a hollow with the enemy in force above us. Late in the afternoon we occupied a very strong position at Haidar Kui, about six miles to the south east of Delibaba, and there we bivouacked for the night. The enemy's camp was believed to

be eight miles in front of us, but his cavalry was within three or four.

It was a pleasant excitement watching our patrols and videttes working their way over the hill. From the points where our main force was about to bivouac we could see both Russian and Turkish outposts. They would occasionally meet in parties of twos and threes round a corner, or over a ridge, when a deal of wild firing and galloping would ensue without any great damage being done on either side. There was an immense deal of peppering, but I think there were only three casualties on our side. Our troops, the Mushir and ourselves included, bivouacked in the open, about 9,000 feet above sea level, and without even a stone to shelter us from a bitter wind which was followed by several hours rain in the early morning. A little biscuit soaked in cold dirty water was our only meal after the bitter night, and on we went very cautiously as before; we had now 20 battalions of infantry, 12 field pieces, 10 mountain guns, and about 2,000 cavalry, mostly irregulars. The enemy's force was unknown with certainty, it was believed to be stronger in artillery and cavalry, but somewhat weaker in infantry. We left the whole of our field guns and five battalions of infantry at Haidar Kui hill to act as a reserve, and to defend our retreat in case we were routed. We started at 5.30 a.m., and by 10.15 got on to the hill where the cavalry skirmishing had occurred the previous evening, but from which the enemy had fallen back as we advanced. When we reached the hill we looked down into the enemy's camp, but at a distance of about four miles. We saw plenty of tents, but the troops were all concealed, and so well was this done, that although I was nearly all day on a commanding eminence in the centre of our position, I never once saw any large body of the enemy's infantry. I only saw them as skirmishers, or in very small bodies, and to this day I don't know the numbers of the enemy's battalions that were opposed to us. I believe there were eight, each battalion being at least double in strength of our own.

Our centre and right occupied the crest of a high flat-topped hill, about a mile in length, facing the enemy's camp, and at right angles to the main road which came direct from this camp up a ravine, and passed over a depression between our centre and left. The hill on which we stood stretched down in gentle undulations towards the camp, which was about four miles distant, and in great measure concealed by knolls and gentle rises. On one of these knolls was

stationed a battery of the enemy, which commenced firing directly we appeared on the crest of the hill. At the same time that our centre and right occupied the long ridge I have described, our left, consisting of two battalions and two mountain guns, took up a position on a high commanding knoll, separated from our centre by a deep valley, at a distance of about three-quarters of a mile from it. In rear of it was a still higher hill, which the Russians were very anxious to get possession of, as had they gained it, and been able to get guns on to it, they would have enfiladed the whole of the rest of our position. The fighting commenced there about noon, and was very severe all day. It commenced by the Russian skirmishers advancing up hill to attack, up a slope of about 30°. A very pretty sight it was; up they boldly came under a very heavy fire. I could see the men dropping, but on they advanced; as they neared the crest, where the Turks had rapidly thrown up some stone intrenchments, the fire became hotter and hotter, and the Russians wavered. At that moment one of our Krupp field guns was brought up to where we (*i.e.*, the head-quarters) were standing, and a couple of shells thrown in amongst the Russian skirmishers finally settled the question, and made them turn and run. Later on in the day they returned to the attack, and actually carried the position; but reinforcements being sent from the reserve at Haidar Kui the Turks re-took the position after some severe fighting.

The fight along the centre and right was mostly infantry *versus* infantry. Shortly after noon three field guns were placed in position on the hill, where I stayed the greater part of the day, the position selected by the Commander-in-Chief from which to direct the battle. Being the most conspicuous point in the whole of our line, it was a position of considerable danger, and throughout the fight, which lasted from noon to sunset, it was the object specially aimed at by three of the enemy's guns placed about 4,000 yards from us, but at a considerable distance below us. I am afraid to say how many shells fell in our immediate vicinity in the day; fortunately, still more passed over us and burst on the reverse slope of the hill. However, I had my baptism of shell fire, and learned before the end of the day to treat it with as much contempt as did the Turks. Ten men and three horses were the only victims to the enemy's shell fire in our portion of the ground. It was wonderful sometimes to see a shell pitch between a couple of battalions of infantry without touching a man. The ground was soft, and the shell getting imbedded before bursting would do little more harm than raise a cloud of earth and dust.

The skirmishers, however, had a much more dangerous time of it from the enemy's rifles. About noon they were thrown forward, not a man of the enemy being visible. One regiment of Nizams advanced from the point where I was standing, three companies skirmishing, one in support, and the remaining half battalion in reserve; they advanced as on parade, and had not got 500 yards to the front when they came in sight of the enemy's skirmishers advancing to meet them; from that time there was one constant fusillade in our front, and all along our line, the line of fire sometimes advancing, sometimes retiring, according as Turks or Russians got the best of it. Our losses were very heavy, as the Russians had several mountain guns in action in various parts of their line playing with considerable effect on our skirmishers, who were also exposed at the commencement of the action to the fire of a rocket battery. The wind, however, was very high, and the rockets very little good, and after the first few discharges I saw no more of them, owing I fancy to our Henry-Martini rifles being a little too near to be pleasant. Later on in the day our mountain guns were pushed to the front, and the artillery that had been left at Haidar Kui were all brought forward; three guns, indeed, came into action at noon, and three others about three hours later on, the remainder were in reserve throughout the day. The battle was principally an infantry fight; our guns being almost exclusively employed playing at long bowls with those of the enemy.

Our cavalry remained throughout the greater part of the day in protected positions on our right and left flanks, they made one or two attempts to attack the enemy's skirmishers in flank, but were invariably repulsed with loss. On one occasion they were pursued by the enemy's cavalry, but rallied behind a battalion of Turks, who opened their files to allow these men to pass through.

As the evening advanced the Russians fell slightly back, but both sides continued firing until dark. At times in the course of the day I thought we were getting the worst of it, the constant flow of wounded coming from the front, each wounded man often supported by two unwounded comrades, made it often appear as if our whole line were retiring; however, the places of the absentees were rapidly filled up from the reserves, and at nightfall our troops found themselves slightly in advance of the position they occupied at the commencement of the fighting. In the night the whole Russian force retired, and our own troops were too exhausted to pursue, even if transport and provisions were present in sufficient quantities,

which they were not, and in these wild mountains where we were fighting no resources whatever were obtainable in the country.

Next day, after another night's bivouac, I accompanied the Mushir over the front of the battle-field; the Russian rear guard fired a few shots at our party at a distance of some 5,000 yards, but the shots fell harmlessly short; working parties were out burying the dead where they lay—four hundred on our side—the Russian dead and wounded had all been removed during the night, with the exception of two bodies which were lying amongst a number of Turks; most of the latter were lying out in the open, their face toward the foe, splendid looking fellows they were, many of them belonging to that Nizam regiment that started work so coolly and bravely in front of me.

I was much struck with the enormous number of cartridges that had been fired away. By the dead body of one Turk I counted no less than 120 empty cartidge cases. I saw many heaps as large both of Turkish and Russian cartridges. One of the reasons given for the loss of the first fight at Tahir was, that the men were unprovided with sufficient ammunition, but at this battle the arrangements were excellent. Every man carried into action 150 rounds of Henry-Martini ammunition, of which about 50 were in his pouch, and the rest stowed away in bags or pockets, or wherever room could be found for them. Many men adopted the Circassian fashion and carried a considerable number in their breasts, two parallel rows of little cloth pockets, each containing one cartridge, being sown on to the tunic.

In addition to this large supply carried by the men themselves each battalion had, or ought to have had, 32 ponies, each carrying 2,000 rounds. This for a battalion of 640 men would give an extra 100 rounds for each man. Now, as a rule, these ammunition reserve ponies were well up with the battalions to which they belonged, and accompanied them on the line of march, and I have seen ponies thus laden carried right up to the line of skirmishers, the men who looked after and led these ponies were soldiers of the battalion. In one point these arrangements were deficient, reserve ammunition was packed in the original unopened boxes in which it came from America, and these had to be forced open on the field, often under fire, causing delay and confusion.

While on the subject of rifles and ammunition I may mention the Turkish cavalry were armed with American Winchester repeating rifles, and nearly all the infantry of the Turkish army in Asia were

armed with the Henry-Martini rifle, some few of them having Sniders. One thing struck me very forcibly, not so much in this battle, but in other skirmishes and fights at a later period of the campaign, and that was at what terrible disadvantage the Turks were at in not having had any previous practice or rifle instruction. I am perfectly convinced that had they had one-fifth part of the instruction given to our own soldiers, they would have killed at least 50 per cent. more of the enemy than they did in the different engagements I witnessed.

As far as I am able to judge from the not very reliable Russian official account of this battle of Yeshek Ilias (or Khalias as it is sometimes called) their losses were not nearly so heavy as that of the Turks. They were much stronger than we were in artillery and cavalry, but we certainly had the advantage in numbers as far as infantry were concerned.

I was surprised to learn the amount of our losses: 400 killed, and perhaps 1,500 wounded; a large number out of the 12,000 men of which our force was composed.

The wounded were all sent back to Erzeroum for treatment, and many of them did not get their wounds dressed until arrival there three or four days after the battle. Our field army was unprovided with surgeons or ambulances, and the wounded had to get back to Erzeroum, a distance of 70 miles, as best they could, some walking, some on ponies, some jolting along in country carts; many doubtless died on the road.

One of the great blots of Turkish military administration is the entire absence of all proper arrangements for the sick and wounded; they simply do not exist at all, at least, I speak of the force I was now with, which later on in the campaign crossed over into Russian territory near Bayazid, where, with a force of 20,000 men including irregulars, we had not a single doctor or surgeon with the force, although we had a standing hospital with two surgeons only, at Bayazid, two days march in rear of our camp.

The battle that I have been describing at some length was fought on the 21st of June, the longest day in the year, and a precious long day it seemed to me; it was the turning point of the campaign. Up to that time the Russians had had it all their own way, but now they had received a check; Mukhtar Pasha who had hitherto done nothing but retire, as the Turkish officers themselves used to complain, whenever he heard the sound of a shot in the distance, had boldly come forward when the crisis had arrived, and within five

days of the disastrous defeat of his right wing at Tahir, had so strengthened and infused fresh vigour into his troops that the enemy received a check, which in conjunction with other causes compelled them precipitately to retire.—What were these causes? While Mukhtar was drilling his recruits and organizing his army at Zewin, the small force which at the commencement of the campaign had retired from Bayazid towards Van, was joined by four battalions which at the outbreak of the war were keeping order in Kurdistan, the whole under Faick Pasha were joined by an immense horde of Kurdish irregulars, and this force with 12 guns advanced to Bayazid, lay seige to the Russian detachment of some 1,500 men that were left there in garrison, and threatened the communications of the Russian left which was commanded by Tergukasoff, one of the best of their Generals; his situatian was most critical and after the bloody battle of the 21st June, he had no alternative but to retire.

And yet at this time another Russian force, some 17,000 strong, was advancing from Kars upon Ezeroum by the Zewin route. Mukhtar heard of its being on the march, and, handing over the command of his right wing to Achmet Pasha, hurried back to Delibaba, and across to Zewin. But he was too late to take part in the battle that took place there. One of the most fortunate, and I must add, one of the most incompetent of the Turkish generals, Ismail Kurt Pasha, had arrived there a few days previously from Erzeroum, and took over the command from Faizi Pasha, who had been left in charge by Mukhtar. The Russians made a fierce atack on the position, but—owing to Mukhtar's wise foresight in having withdrawn nearly all his troops from his left, in order to strengthen his centre and right—the Turks, although outnumbered, made such a gallant resistance to the brave oft-repeated assaults of the Russians, that the latter, after a day's hard fighting, and suffering tremendous loss, had to draw off thoroughly beaten, and retire discomfited to the neighbourhood of Kars. This battle took place on the 25th June—four days after Mukhtar's victory on the right.

This battle terminated what may be called the first period of the campaign. I have gone into such detail that, my time being limited, I can only glance very rapidly at what followed.

Mukhtar Pasha, subsequently to the battle of Zewin, slowly and cautiously advanced to the relief of Kars; which place he entered without any further fighting on the 8th July; the Russians having raised the siege on the previous day, and fallen back in the direction

of Alexandropol. Mukhtar slowly followed, withdrawing the greater part of the Kars garrison to augment his own army, and, getting up continual reinforcements from the rear, he manœuvred about for a long period in the hills lying to the S.E. of Kars.

After several unimportant engagements, in which the Turks generally succeeded in getting the best of the fighting, Mukhtar, on the 25th August, attacked the Russian positions, and captured by storm the hill called Kizil Tepeh, which up to that time had formed the Russian centre. The enemy made desperate but unsuccessful efforts to retake it, and lost very heavily: the killed and wounded on both sides amounting to several thousands. It was for this exploit that Mukhtar was rewarded by the Sultan with the title of Ghazi, *i.e.*, victorious against the infidel. It is believed by many whose opinion is entitled to weight, that had Mukhtar followed up this victory, and attacked the Russians at Kurukdarah, the latter might have been driven into Alexandropol; but my own opinion is that his force was not sufficiently strong to do this. He had dangerously weakened the garrison at Kars. I believe at one time there were only four battalions left there—an insufficient force to have held it against a *coup de main* which might possibly have been attempted from the side of Ardahan had the Turks moved too far to the front.

September passed with the two armies still facing each other, and no decisive fighting occurred. But all this time the Russians were hurrying up reinforcements on a very large scale; while the Turkish army instead of getting stronger was daily getting weaker. The Circassian irregular cavalry was rapidly dwindling away. It is reported that on one occasion Mukhtar executed a Circassian for murder, and that on the following day 1,000 of his countrymen deserted *en masse*. In the beginning of October the Russian army had received two complete new divisions, aggregating at least 30,000 men—complete, with artillery and cavalry—and could put in line probably some 60,000 men, with 200 guns and a very large force of cavalry. Mukhtar's force probably did not exceed 30,000, with a still smaller proportional force of artillery and cavalry. On several days early in October the Russians made a series of badly-conceived but bravely-executed attacks on the Turkish positions; and the losses on both sides were enormous. Although the Russians were repulsed, Mukhtar's losses were so heavy, and he was so outnumbered, that on October 8th he retired from the Kizil Tepeh, which he had held since the 25th August, and took up the line

of Yagni-Aladja. On the 15th October the Russians made the final attack, when, outnumbered and out-manœuvred, the Turkish army was cut in two, and after some desperate fighting the right half, cut off from Kars and from all hopes of retreat, laid down its arms; the left half, shattered and disorganized, took refuge in Kars.

On the following day Mukhtar re-issued from Kars at the head of about 3,000 men, and retired rapidly towards Erzeroum, leaving in Kars a garrison of some 15,000 men, of whom at least 5,000 were sick and wounded.

Meanwhile, what had been going on on the Turkish right and left? On the left, at Batoum, Turks and Russians remained *en face*, as they had done ever since the beginning of the war. The Turkish entrenchments were so strong that the Russians, who had unsuccessfully attacked them in the month of May, had never tried another assault; and Dervish Pasha, who had succeeded Hassan Pasha in command, early in the campaign was quite satisfied with holding his own. Both armies suffered very severely from illness, as the country is most unhealthy.

The right wing which we left bivouacked on the battlefield of Khalias on the 22nd June pursued the retreating force of Tergukasoff. The Turkish column was commanded by Ismail Pasha, who joined it a few days after the battle of Zewin, where it will be remembered he was in command of the Turkish centre. He attacked the Russian rear at Zedikhan, where he captured 800 sacks of flour, and large supplies of wheat, and again at Kara Kilissa; but the Russian generalship was far superior to that of the Turks, and the Russians not only carried off in safety their guns and nearly all their baggage, but also took with them almost the whole of the Christian (Armenian) inhabitants of the Alishgird valley. These were all safely conducted *viâ* Mussin across the frontier to Igdyr, and other villages in the Erivan plain. Ismail Pasha leisurely followed. The energetic Tergukasoff having deposited his charges in safety, re-crossed the mountains by another route, with eight or ten battalions of infantry, 24 guns, and a large force of cavalry, and boldly attacked Faik Pasha, who was then besieging the Russians in Bayazid. Faik Pasha bungled terribly. He left the whole brunt of the attack to fall upon two battalions, which with three mountain guns occupied heights commanding the citadel, which was still held by the Russian garrison—sadly reduced in numbers, and nearly worn out by hunger and thirst. The garrison had some days earlier offered to capitulate, and the soldiers were, in fact, issuing out unarmed,

in order to give themselves up, when they were set upon by the treacherous Kurds, and more than 100 of them were cruelly massacred before the others had time to shut the gates and save themselves. After this they naturally said they would rather perish than hand themselves up to such treacherous enemies.

However, to continue our story. These two Turkish battalions and three guns had to bear the brunt of General Tergukasoff's attack, and being strongly posted they fought well for several hours, but Faik Pasha failing to come to their assistance, and the cowardly Kurds having retired at the commencement of the attack, the Russians captured the guns, drove off the covering battalions, released the garrison, and carried them in safety back to Igdyr. The relief of the garrison took place on the 10th July, *i.e.*, a few days after the relief of Kars by Mukhtar.

And while this bold feat of arms was performed, where was Ismail Pasha with his large force? Why actually within sight. It is to his eternal discredit that he allowed the garrison of Bayazid to be carried off under his nose, when by a vigorous attack he ought to have annihilated the army of Tergukasoff. He did indeed write a despatch to the Porte, in which he stated that he attacked the Russians as they retired, and drove them off with a loss of 500 men left dead on the ground. The facts are that his advanced guard fired a few cannon shots at them when out of range, and that Ismail Pasha and the force at his disposal did not cause the loss of a single man to the Russian general.

The latter now retired to Igdyr, and occupied in force the passes leading from Bayazid to Russian territory. Ismail, having effected a junction with Faik Pasha, remained inactive, encamped within a few miles of Bayazid.

As fate had decreed that I was to join Ismail at Bayazid, and accompany him through the rest of the campaign, I will here revert for a moment to my own history. After Mukhtar's first victory, on the 21st June, I returned and paid a flying visit to Erzeroum, after which I rejoined Mukhtar in his advance upon Kars. I entered that place three days before the Russians retired from it, *i.e.*, I was there for three days during the Russian bombardment, of which I will only here say that during the 21 days that it lasted it has been estimated that some 48,000 shells, most of them of 6-inch diameter, were thrown into the town and surrounding forts; and that during the same period the total number of casualties from the bombardment amounted amongst the gunners to 20 killed and 48 wounded, and

amongst the infantry and towns-people to 85 men killed and 155 wounded, and some four guns were disabled, *i.e.*, one person was struck for every 136 shells fired, a result somewhat disproportionate to the means,—though one thing that has astonished me throughout the campaign is the marvellously little harm that is done by percussion shells at long ranges. The Russian batteries at Kars were at least 4,000 yards from the principal forts.

One other fact and I have done with Kars. I saw two Russian guns at about 10,000 yards distance; and Hussein Bey, the Turkish Artillery Commandant, told me that they too were sometimes employed in the cannonade, but that his guns would carry equally far. I could not believe him, and defied him to send a shot near them. He sent a shell from a 13 centimeter Krupp, the gun being raised to an elevation of about 30°. Our shell burst apparently within 50 yards of the Russian battery. They replied with several shots, not fired at us but on a more advanced battery; and I noted the average interval between the flash and the arrival of the sound to be 32 seconds of time, from which I should judge the range to have been about six or seven miles.

From Kars I was sent by Sir Arnold Kemball to join Ismail Pasha's force at Bayazid, and in conjunction with my colleague Captain McCalmont to try and put a stop to Kurdish atrocities, fearful accounts of which had reached the head-quarters camp.

Escorted by a dozen most ferocious-looking and bloodthirsty Kurds, we went across country by Kaghizman to Bayazid, a journey which we performed with considerable difficulty, and not without danger, in four days. We were once fired at on the road by timid villagers, who mistook us for robbers; and subsequently, when ahead of our escort, were nearly cut down by some Circassians, who mistook us for Russians; and when we got into a more civilized neighbourhood, we were all but eaten up with vermin. In crossing from Kaghizman to the Alishgird plain, a snowy mountain range is traversed. The path was very bad. We were fortunately not much encumbered with baggage, for our beds and nearly all our bedding had been left in Erzeroum, and we did not recover them till some months later, until which period we had to sleep on the ground.

We joined Ismail Pasha on the 20th July, *i.e.*, ten days subsequent to the relief of the Russian garrison at Bayazid. His force, which was encamped three miles distant from the ruins of Bayazid, consisted of about 14,000 regulars, 30 field guns, 12 howitzers, and about 6,000 irregulars (mostly Kurdish cavalry); and there, living

in a soldier's small bell tent, we remained stationary and inactive for a fortnight—suffering terribly from heat, dirty water, and a perfect plague of flies. We daily received accession of strength from the most remote parts of the country—Arabs from beyond Baghdad and from Syria—and old Ismail succeeded in getting rid of large numbers of Kurds who had been participators in a terrible tragedy at Bayazid during the siege. On the day after the massacre of the 100 Russians while issuing unarmed from the citadel (to which I have already alluded), there was a general massacre by the Kurds of the christians in Bayazid. Some hundreds perished—men, women, and children—and the survivors fled across the frontier into Persia, where they were succoured and well treated. It is a terrible tale, which I shall not dilate on here—suffice it to say that when I visited Bayazid, although parties of soldiers were still engaged in burying the dead, there were many unburied bodies lying about in various stages of decomposition, and one more than ordinarily horrid sight I saw was two dogs quarrelling over a human head. Not a soul was to be seen except the soldiers engaged as above; all the inhabitants had perished or fled.

On the 4th August we commenced some interesting operations, and, through Russian mismanagement (I suppose from what they knew of Ismail Pasha's generalship, they thought he would not have the pluck to cross the mountain range which divided the Russian main camp at Igdyr from ourselves), on the morning of the 7th August, our advanced guard, consisting almost entirely of irregulars, surprised the Russian force in the pass, and scattered it after a feeble resistance. The next day our whole army crossed the frontier, and established itself at and in the neighbourhood of the village of Zor, some two hours across the frontier. And there we remained, encamped in Russian territory, for two and a half months, *i.e.*, from 7th August to 16th October, perched up on a perfectly arid stony hill side, suffering the greatest possible inconvenience from heat, dirt, flies, vermin, want of water, stinks, and other abominations,—oppressed by *ennui*, but bound by our instructions to remain where we were—we existed, rather than enjoyed life. The Russian army was encamped at our feet, one detachment at Igdyr and the neighbouring villages (some 2000 feet below ourselves, covering the road to Erivan and the fertile plain by which it is surrounded), another detachment at Kulp to prevent our marching across the barren stony hills on our left to join Mukhtar Pasha, who, poor fellow, was fighting hard for the existence of himself and his army, while we were idling away

our time in doing nothing. Our only consolation in looking on the Russian camp below, was the certainty that they were in a hot and steaming temperature, and probably still more uncomfortable than ourselves. They suffered much from cholera and dysentery, the effects of hot climate and overabundance of fruit, the latter a luxury, which, as well as vegetables and everything green, we had to dispense with for months. We had no general battle on a large scale the whole time we were there. The Russians flooded the plain, and we entrenched ourselves in the hills. They were funky, and we were afraid. Of course there was a good deal of marching and counter-marching, feints and false attacks, and we had a great many very interesting artillery duels with the Russians, in which we generally got the best of it. The gunners had plenty of practise at living targets, and as we had with us 500 rounds of ammunition for each one of our field guns, there was no need to stint the gunners. Other little *divertissements* there were. On one occasion I accompanied a band of 2,000 Bashi-Bazouks to attack a detachment of five squadrons of Russian dragoons, and after some very pretty manœuvring the Russians got safely away, our Kurds holding off as soon as there was a prospect of hard fighting. On another occasion our left wing got engaged with the enemy, and we lost about 150 killed and wounded, the enemy losing as much or more. On another occasion a large force was sent off to attack the enemy at Kulp. After marching all day in terrible heat we arrived late in the evening at some heights overlooking the plain, most fortunately in time to see for ourselves that the enemy's force was three times as strong as we expected, and about twice as strong as our own; so after a short halt we started to go home again. We were overtaken on our mountain road by a fearful tempest, and did not get back to camp till noon the next day, after the most awful night on horseback I ever spent—and I can tell you I spent some hard nights during the campaign.

Of course, if I had time, I could give you many amusing and instructive stories, but I must bring my lecture to a conclusion.

On the 16th October, the Russians in camp below us fired a salute of 101 guns: it was to celebrate their great victory at Aladja Tagh. Ismail's telegraph was generally out of order, but most fortunately for us on that day it was working well, and by evening he learned from Erzeroum of Mukhtar's crushing defeat on the previous day. There was no time to lose. That evening we struck our tents and retired from a somewhat advanced position we had taken up a few

weeks previously, back to the positions we had occupied on first crossing the frontier—a much stronger and easier defensible position. It took us all the night to effect this, and in the morning we pitched our tents as if nothing had occurred, and old Ismail gave out publicly that the salute fired on the previous day was to celebrate the accession of the Czarewitch in place of the Czar, who had abdicated. I believe the old fox really wanted to fight the Russians at last, and hoped they would come up and attack. Well, on the 18th the enemy did come. They thought they would catch us on the march, and had they done so they would very likely have annihilated us; but old Ismail remained firm, he left his tents standing and awaited the attack. On came the whole force (horse, foot, and artillery, a most imposing sight) until they were lost to view under the lee of the hills at our feet. Their artillery opened fire--some 40 pieces. We had 36 guns, manned by skilled, brave, and well-trained gunners. One of our batteries of six guns completely silenced a Russian battery of eight, and drove every horse and man away from the guns. Their other guns could make no impression. Their infantry remained concealed in the ravines, ready to attack, but the failure of their artillery to produce any impression made them change their minds, and shortly after sunset they returned to their camps, having been under arms since three o'clock in the morning.

No sooner were their backs turned than we received orders to strike our tents, and commence our retreat. At 11 o'clock everything was ready, surplus stores which we had no carriage for were destroyed, and off we went as fast as we could go, and never stopped till midnight on the following night, by which time we had marched 25 miles, and put two mountain passes between ourselves and the enemy. We bivouacked for four hours only, in pouring rain, without food, without firewood. There was just time for Ismail to concoct and circulate amongst the troops a fictitious telegram to the effect that three Russian generals and 40,000 men had capitulated in the Schipka Pass. The men actually believed this for three days, and it raised their spirits wonderfully. From our bivouac we sent off six battalions and nine guns towards Van, and then continued our road, marching another 25 miles before we halted, and leaving a fearful number of stragglers by the roadside to perish of cold and hunger.

On Sunday, the 21st, we halted a day, and then pushed on as hard as we could—marching day and night—resting for a few hours here and there when we could. Rain poured in torrents, making it

extremely difficult and a work of very great labour to get the guns through. In many places they had to be dragged by men, and in one pass it took eight hours to get our 33 guns across, delaying the line of march terribly, but we had a good start and we kept it.

At Mussin the Russian cavalry entered the village two hours after we evacuated it, but their artillery and infantry were a long way behind, and could not afford to march as rapidly as we did, for our loss of life must have been great, as many a poor fellow laid down by the roadside never to get up again; but the army, the whole of our guns, and an enormous train of ammunition was saved. At last, on the 26th October, we safely reached the critical part of the road. At the entrance of the Delibaba defile is a position which, had it been occupied by 5,000 Russians before our arrival, our army would have been destroyed. In addition to Tergukasoff's force (stronger in number than our own), which we knew was following behind us, another column under General Lazaroff, one of the best of the Russian commanders, was marching from Kars for this very point, to try and cut us off. Thanks to a bold movement of our old and beaten but always plucky friend, Mukhtar, whom we last noticed on the 16th October, retreating from Kars with 3,000 men,—thanks, I say, to a very plucky action of his, which few people ever heard of, and which I only learned from his own lips several days later on,—General Lazaroff's force was delayed one day, and we were saved. I had the great satisfaction of standing with old Ismail (who really had conducted this retreat with marvellous energy and judgment) on the top of the hill overlooking the defile, watching our long train of baggage and ammunition animals, nine miles in length, wending its way through the pass, followed by the troops; and just as the last of our 38 guns passed through, we saw with our spy-glasses on the opposite side of the Araxes, at a distance of about three hours off, the head of General Lazaroff's column—just four hours too late. That same evening late I was in Kuprikui, and early next morning in Erzeroum.

Ismail and Mukhtar united their forces, but Ismail's rear-guard was surprised by the Russians at Hassan Káleh. The great body of his regular troops got safely back to the Deveh Boyun position in front of Erzeroum, but the whole of the irregulars had melted away during the retreat.

On the 4th November, the Russians attacked Mukhtar's position at Deveh Boyun. I was present at the battle, and remained in the field till past sunset, when the whole of the Turkish army was in full flight

to Erzeroum. The Turkish force, all told, had mustered about 15,000 men, with 76 guns; the Russians had double the number of men The line of defence was seven miles in length. The Russians attacked on the extreme flanks, but were repulsed,—attacked again and again, until Mukhtar was obliged to weaken his centre to support his wings. Old Ismail was cannonading on the right, and, I believe, fighting bravely. Suddenly the Russians attacked our weakened centre with enormous force. Their powerful artillery had played fearful havoc before the infantry advanced, the brigadier was killed, and our weak battalions did not wait the shock, but, closely pursued by the Russians, abandoned the strongest portion of the whole line, and it was a *sauve qui peut* into Ezeroum, only two hours distance. Mukhtar remained on the ground, fighting to the last, but had at last to retire, leaving more than half his guns and all his camp in the hands of the enemy.

The rest of the tale is soon told. Kars fell ; Erzeroum held out and was never taken during the war, but during the four following months it is said that from 15,000 to 20,000 Turks died of typhoid fever. The remnants, under Ismail, who was attacked with that dire disease but recovered, are, I believe, now in Erzinjan. Mukhtar still enjoys, and deservedly enjoys, the confidence of his sovereign, and is in command of the troops at Constantinople. While his brother Gházi, the equally deserving Osman and the hero of Plevna, will doubtless once more come to the front should the Turks ever again take the field against the Russians.

H. T.

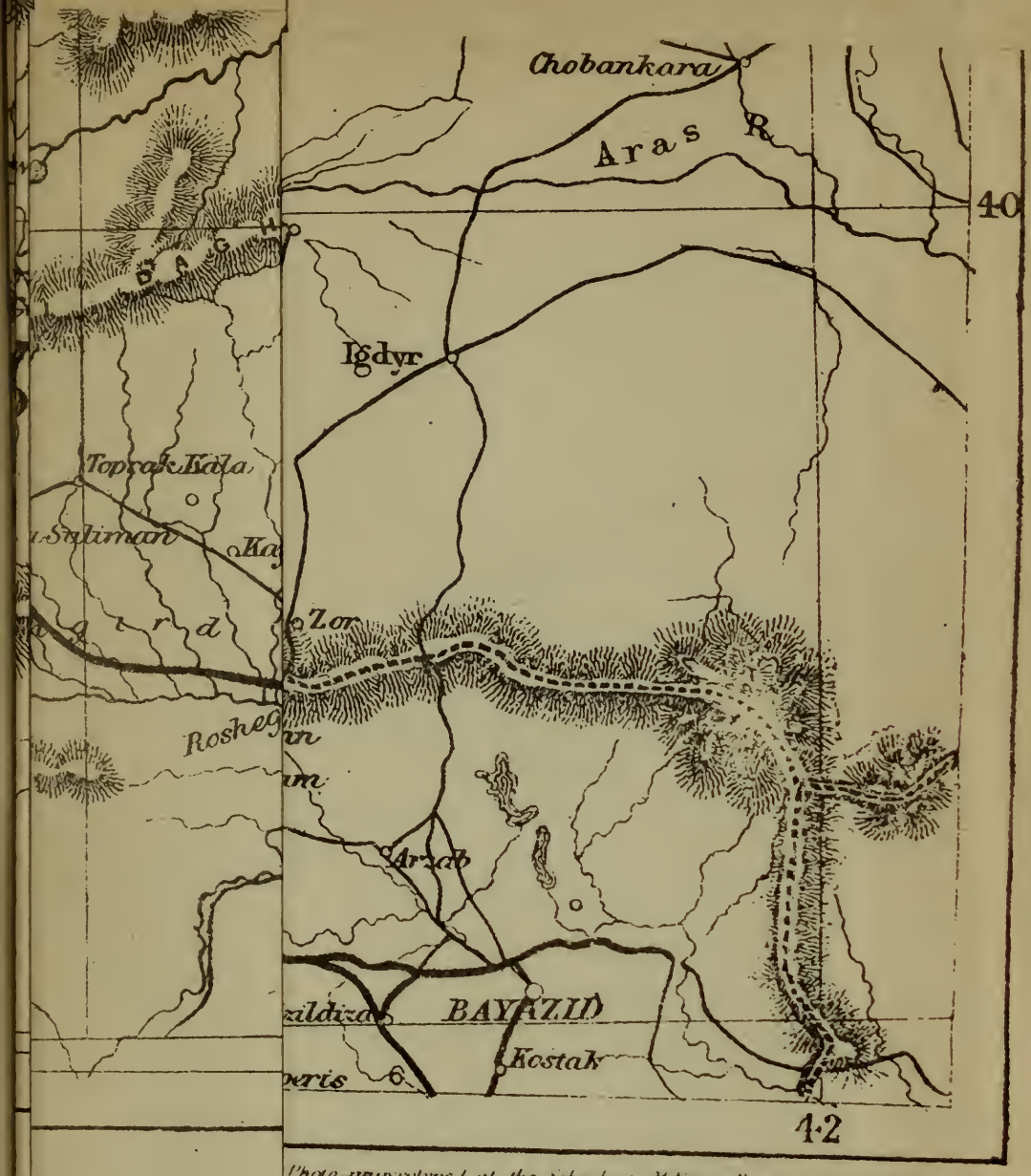


Photo prepared at the School of Military Engineering, Chatham.

MAP OF
ARMENIA.

37° 38° 39

41

TREBIZOND

BATOUM

Artvin

Djevizlik

Khamsikun

Ispir

Ardasa

KOLAO

Tchuruk

Bertakrak

Olti Tchai

Lagos

Karmenak

Olti

Sw

Dzevizlik
Khamskuh
Ardasa
Gumush khane
Baiboort
Helkid
Kara Kilissa
ERZENGJAN
Mama Khatoon
Yenikan
Aladja
Karabooyak
Ilidja
ERZEROUM
Hassan kale
Olti
Narman
Kroloo
Passin Su
Scale of English Miles
37°
38°
39
40

Djevizlik
Khamsikun
Ardasab
Gumush khane
Baiboort
Malussa
Balakhor
Kharput
Mirad Khan
Kolb
Vard
Ispir
Barka
Hushur
Karmenik
Tchuruk
Hertakrak
Oiri Tchai
Olti
Narman
Akha
Ishgan
Bughaa
Bar
Kizilkilissa
Kara Gheu
Tatta
Hinkz
Tatawankiu
Yeniskuu
Surbahan
Ogomi
Kuli Vaqund
Hassan kale
Erzeroum
Palak
Passin Su
Kiroloo
Ardost
Amrakom
Alashkert
Alla Kilissa
Sanamar
Melkid
Kara Kilissa
ERZINGIAN
Kharpan
Mama Khatoon
Yenikui
Ashkale
Karabooyak
Aladja
Meg Mansur
Parmakapan
Ilidja
Narkuah
Ilgin
Barragatch
Kara Meden
Kop
Ilgarin
Ardasab
Vard
Kolb
Tchuruk
Sw
Borjum
Tchakur
Ishgan
Akha
Bughaa
Bar
Tatta
Hinkz
Tatawankiu
Hassan kale
Erzeroum
Palak
Passin Su
Kiroloo
Ardost
Amrakom
Alashkert
Sanamar
Alla Kilissa
Yeniskuu
Surbahan
Ogomi
Kuli Vaqund
Melkid
Kara Kilissa
ERZINGIAN
Kharpan
Mama Khatoon
Yenikui
Ashkale
Karabooyak
Aladja
Meg Mansur
Parmakapan
Ilidja
Narkuah
Ilgin
Barragatch
Kara Meden
Baiboort
Malussa
Balakhor
Kharput
Mirad Khan
Gumush khane
Ispir
Barka
Hushur
Karmenik
Lagos
Olti
Narman
Akha
Bughaa
Bar
Kizilkilissa
Kara Gheu

ALEXANDROPOL
(Goumri)
KARS
ERIVAN
BAYAZID
Olti
Pertes
Penneh
Narman
Urut
Djadjur
Karakli
Kazarabad
Sardarabad
Chobankara
Igdyr
Hullouk
Assar
Kulpi
Kagizman
Natcheran
Tchetchian
Melikli
Kiroloo
Hassan kale
Aras R.
Arpa Tchai
Olti Tchai
Passine Su
Scale of English Miles
10
20
30
40
50 Miles

PAPER XI.

DEMOLITION OF A FACTORY CHIMNEY

AT

RINGSEND, DUBLIN.

By Major G. W. Stockley, Royal Engineers.

A gentleman owning an old glass factory at Ringsend, Dublin, and wishing to clear the site on which it stood, applied to the Commanding Royal Engineer to undertake the demolition of the factory chimney; the authority of the Inspector General of Fortifications having been obtained, this was successfully carried out on the 26th April.

The chimney was 65 feet in height, and of medium quality brickwork, the rectangular base with arched openings (as may be seen on reference to the drawing, which gives all the dimensions) offered very favourable conditions for demolition, and the outer walls of the factory, which were still standing, afforded a screen to prevent the possibility of an accident from splinters.

It was decided to throw the chimney down in the direction of the open fields to the eastward, and therefore four charges were placed in each of the two piers supporting that side. Chambers, large enough to take a half-pound disc of gun cotton, were cut into the centre of the wall by means of chisel and hammer; this operation took a bricklayer about four hours.

The charges were calculated as LLR^3, *i.e.*, one third of those recommended for gunpowder similarly placed, without tamping.

LLR was 9 inches. Therefore LLR^3 was $0{\cdot}75^3$, or 0·42 lbs. (taken approximately as $\frac{1}{2}$ lb.). The charges in the angles were increased to $\frac{3}{4}$ lb.

Actual weight of guncotton used:—

8 primer discs of 9 oz. each	...	=	72 oz.
1 ordinary disc of 8 oz.	...	=	8 ,,
Total	...	...	80 oz. = 5 lbs.

One No. 13 detonator was placed in each charge, and exploded by means of a quantity dynamo-electric apparatus; they were arranged for convenience in two circuits of four each; the apparatus was previously tested and found capable of firing 30 fuzes in continuous circuit.

The demolition was effected without violence; the chimney was seen to shake, and then lean over until it assumed an angle of 60° with the horizontal, when it fell to the ground, the top appearing to strike it at a distance of 30 feet from the base; the space occupied by the debris is indicated by a dotted line on the plan, and did not extend, at the furthest, beyond 50 feet.

G. W. S.

EVATION OF CHIMNEY AT

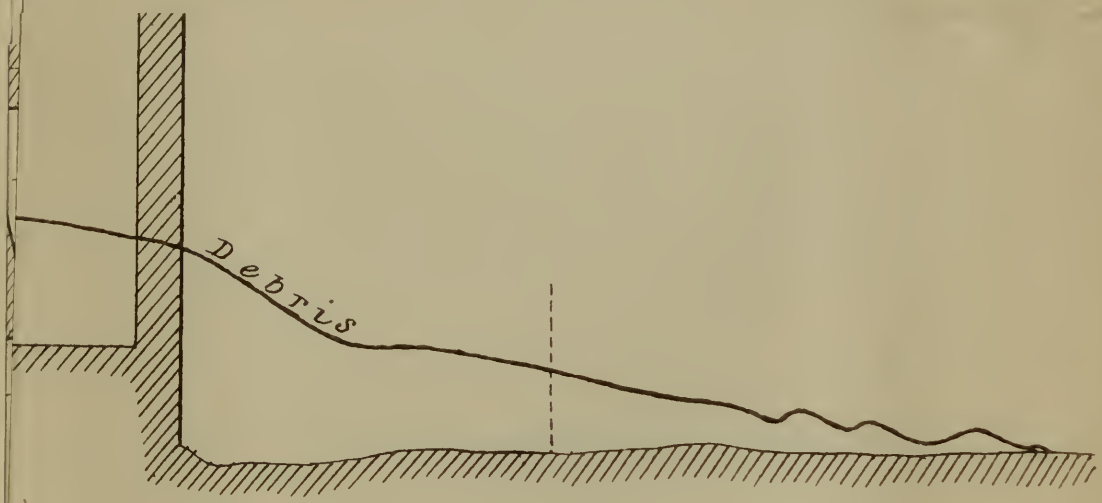
A

ND, DUBLIN.

ges of Gun Cotton on the 26th April, 1878.

cale for Plan and Elevation

20 30 40 50 Feet

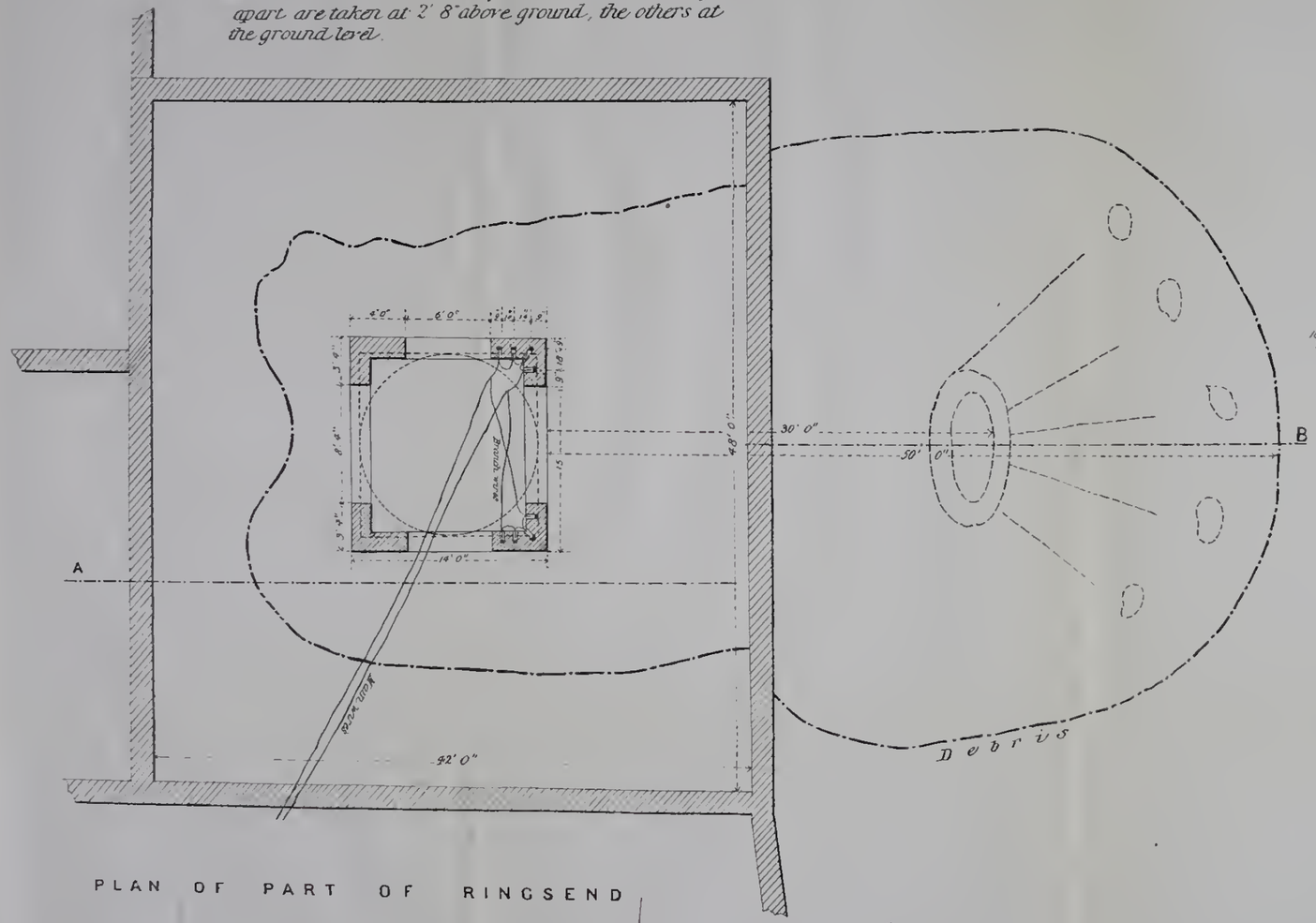


PLAN AND ELEVATION OF CHIMNEY AT
RINGSEND, DUBLIN.

Demolished by charges of Gun Cotton on the 26th April, 1878

PLAN

Note — The dimensions shewing distances of the charges apart are taken at 2' 8" above ground, the others at the ground level.



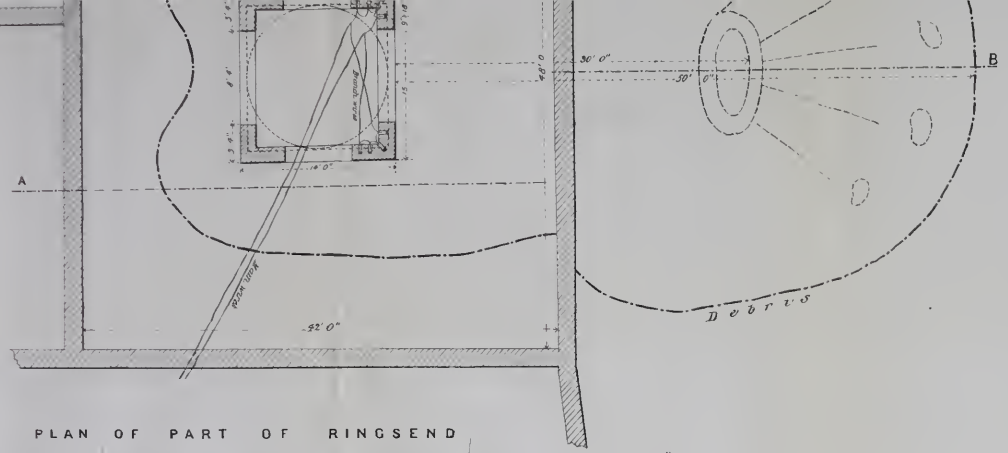
Scale for Plan and Elevation

10 5 0 10 20 30 40 50 Feet

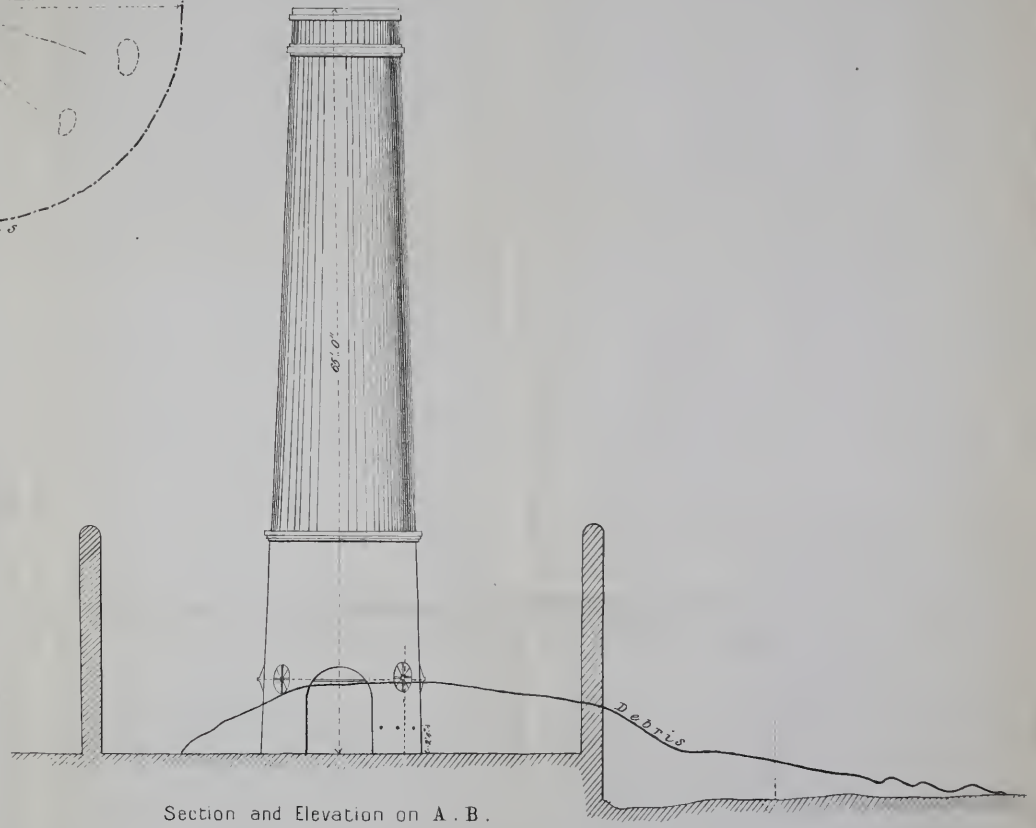
Scale for Site Plan - 5 Feet to a Mile

100 50 0 100 200 300 400 500 Feet

PLAN OF PART OF RINGSEND



PLAN OF PART OF RINGSEND



Section and Elevation on A . B .

PAPER XII.

THE

ENTRENCHED CAMP OF PLEVNA,

FROM THE *Revue Militaire*, 8TH JUNE, 1878.

TRANSLATED BY CAPTAIN C. WOODWARD, R.E.

Being an extract from the Russian "Voïennyi Sbornik," for May, 1878.

MOST of the works at Plevna were closed square redoubts, having in the interior a traverse in the form of a cross. Their sites were chosen with great intelligence, and their construction was perfectly in accord with the requirements of the ground; but it is a matter of suprise that the Turks should always have preferred the quadrangular form, and so deprived themselves of the means of sweeping the ground in front in the most efficacious manner. Apparently, however, the works were intended as *points d' appui* for the troops, to enable them to hold as long as possible a given position. The ground in front was swept by rifle fire from the musketry trenches, supported by the redoubts, the long faces of which served to flank these trenches. To give solidity to these *points d' appui*, their parapets were of a profile, and of dimensions which rendered an attack *de vive force* very difficult.

The parapets were not high (see Section I.), having generally a height of 6 feet to 7 feet, but from the Russian positions they appeared higher. The thickness varied very much: on faces exposed to artillery fire it was as much as 20 feet, at the gorges and in the works of the second line it was 7 feet to 10 feet. The exterior slopes were about $\frac{2}{1}$, and in some works were revetted with sods, and even gabions, especially in the faces not exposed to artillery fire; in the faces directly exposed to artillery fire the slopes were less steep.

To protect the works from escalade, the exterior ditches were 14 feet to 20 feet wide, with a depth generally of 10 feet. Owing to the stiff nature of the soil the scarps and counterscarps were nearly vertical; in most cases berms were dispensed with.

In the interior of the works the most striking feature was the number of traverses, which in some redoubts so cut up the interior space as to render the transport of guns and ammunition wagons impossible. To the invariable cross shaped traverse, others were generally added, after the direction of the Russian fire became determined.

In works of other forms the disposition of the traverses naturally depended upon the trace, but everywhere they were very numerous. Moreover, to protect the faces against enfilade, traverses much higher than the parapets were arranged along them. On the other hand, the interior traverses, or *parados*, were of the same heights as the parapets, or exceeded this height by a few feet only. Their thickness was generally 14 feet, some were arranged for the interior defence of the work, but usually they were exclusively designed to cover a portion of the garrison, lodged behind them in sunken shelters, or for the protection of guns and ammunition wagons drawn up behind them. To furnish the earth for these traverses, the terreplein of the redoubts was excavated 2 to 3 feet below the level of the ground

The redoubts were usually armed with two to six pieces, firing *en barbette* between *bonnettes*. When the pieces were not required they were withdrawn into shelters excavated for them in rear of the parapets, or in the traverses. They were provided with powder magazines, generally arranged under the traverses.

Banquettes for infantry fire were constructed along the crest: in addition, there was in nearly every work a covered way consisting of a trench dug 2 feet or 3 feet in front of the ditch, affording a second line of fire; in some works a second advanced trench gave a third line.

The entrance into the redoubts was always perfectly covered by the fire of trenches dug in rear of the works, and by that of the interior defensive traverses.

The lodgment of the garrisons of these redoubts deserves particular attention, and never before, probably, had so complete and judicious an application of earth-covered shelter for barrack purposes been made. They were arranged either immediately

behind the parapets under the banquettes or barbettes, or behind the traverses, completely protected from shot passing over the covering mass. In some redoubts these sheltered lodgments were constructed in the ditch, and under the counterscarp, but these seem to have been abandoned before the surrender, probably on account of the Russian fire.

The interior of the works could, naturally, only contain a limited amount of these lodgments. They were, therefore, apportioned to the artillery, the infantry being provided with shelter outside the work, under the trenches on the flanks and in rear. Similarly, the reserves were established in trenches, placed at a certain distance in rear, communicating by covered approaches with the redoubt. These lodgments were arranged as in sections Nos. 3 and 4. They were formed by excavating a space 7 feet wide, 14 feet long, and $4\frac{1}{2}$ feet deep, with vertical sides; this was covered over by a roof of hurdle work, sloping from a central ridge, and supported on posts; over the hurdles a layer of straw or sods was spread, then a layer of earth 1 foot to 3 feet thick. The dimensions of the lodgment were modified according to the site, and the number of men for which it was intended.

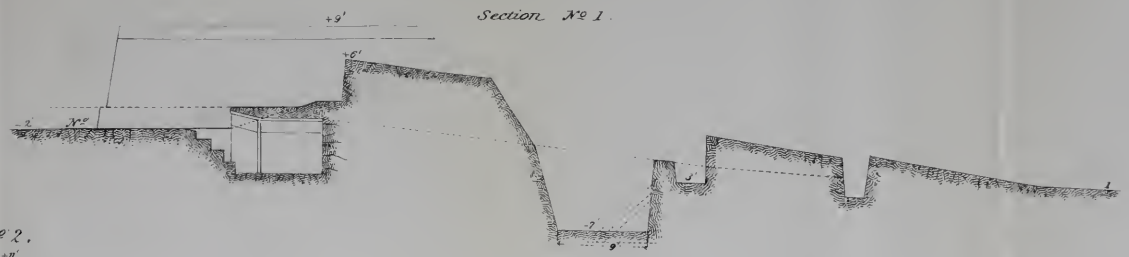
The parapets of the trenches were usually very slight, from 2 feet to 3 feet high at most; the ditches were equally weak; they were 3 feet deep, and 4 feet wide, with a step serving as a banquette. The troops occupying them were lodged in shelters under the covering mass, or under the reverse of the trench. There was thus no provision for entering or leaving the trenches.

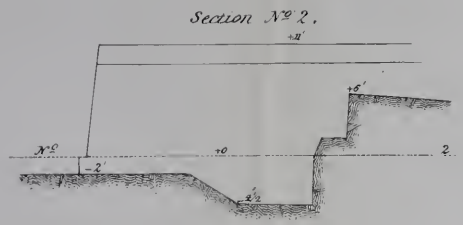
In front of the first line of trenches, at 300 to 400 paces, the Turks constructed shelter pits for a section or half section of riflemen. There is nothing particularly interesting about these, except that circular shelter pits were dug, 18 to 20 paces in front of them, for single sentries. These "sentry-pits" were connected with the shelter pits in rear by a trench, or by a very narrow ditch.

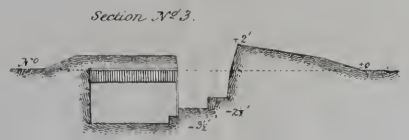
C.W

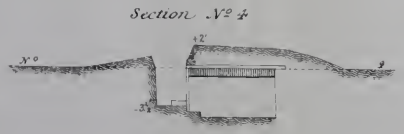
Types of the Works executed by the Turks around Plevna.

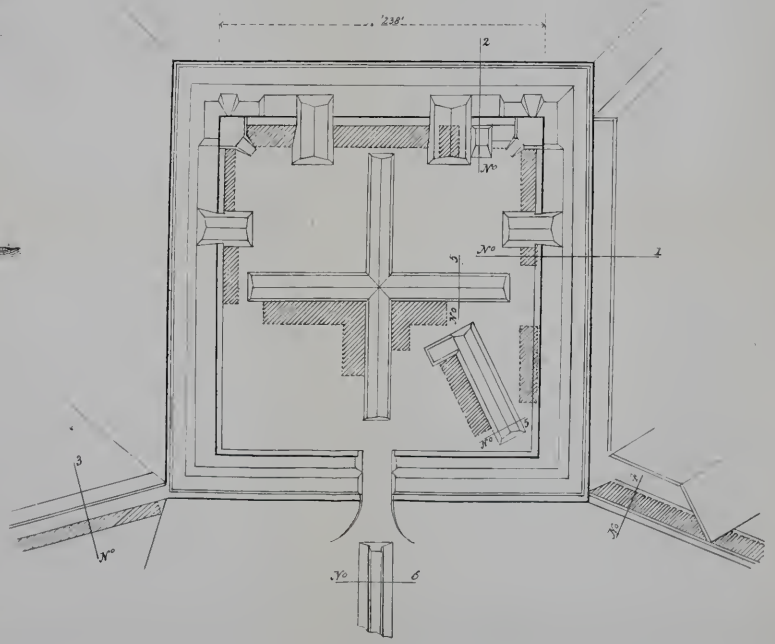
{ From the Voiennyi Sbornik. }

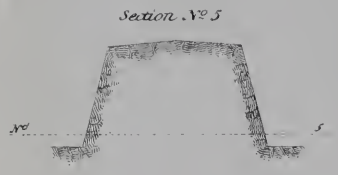












Scale for Plan

0 50 100 200 300 English Feet

Scale for Sections

0 5 8 10 20 9 40 English Feet

PAPER XIII.

EXTRACTS FROM

"INSTRUCTION SUR LE SERVICE DE L'ARTILLERIE DANS UN SIEGE,"* 1876.

By Captain T. Fraser, R.E.

This pamphlet, which reached us in 1877, is one of a series of official text books issued with the approval of the French War Office. It purports to sketch the progress of a siege as far as the duties of the Artillery are concerned.

The following seem to be the most notable conclusions that are come to on the more open questions of the subject:—

In speaking of attack by "assault," *i.e.*, by open force, it is suggested the batteries should be at from 1,500 to 2,000 yards from the works. (p. 5.)

The strength of an investing force is laid down as probably from two to three times that of the garrison. (p. 11.)

The main portion of the first line of investment, with artillery in rear of it, will be from 3,280 to 4,380 yards from the advanced works, with an outpost line 1,100 to 1,640 yards in advance (p. 12.) The reserves being 8,750 to 10,936 yards back from the place. (p. 14.)

In an attack on a chain of forts it is suggested that the capture of one or more be followed by an attack directed on one or two collateral forts, and at the same time against an intermediate position between the forts and enciente. (pp. 16 and 17.)

The artillery of investment should resist sorties, and should not engage with the fortress guns. (p. 20.)

---

* Sold at the Libraire Militaire de Berger—Levrault & Co., 5, Rue des Beaux-Arts, 5.

The siege corps, including investing force should be from three to four times the garrison. The siege artillery should vary in strength according to the number of guns and in the proportion of 25 to 30 men per gun. The Engineers, exclusive of those for railways and telegraphs, should be, at least, twice as numerous as with a field force.

If the lateral communications be bad, several artillery parks may be required. The main park to be, say 8,736 yards from the fortress. (p. 23.)

The main powder magazines should be in secure positions 200 yards apart, and should hold from 120,000 to 240,000 lbs. (p. 25.)

Intermediate ammunition depôts for 24 hours' supplies are placed in rear of the first artillery positions. (p. 26.)

The Officer Commanding Royal Artillery and the Commanding Royal Engineer should be quartered near each other. (p. 27.)

The first artillery position will, if possible, be at from 2,187 to 3,281 yards from the place, and protected by the line of investment, somewhat thrust forward if need be. (p. 29.)

The batteries should be grouped with a view to facilitate command and control of fire. It is mentioned that in the Crimea a screen parapet 54 to 65 yards in advance was found a protection. (p. 30.)

Some of the sites for the first batteries should be so chosen as to be serviceable throughout the siege.

Batteries are generally made for from four to six pieces. (p. 31.)

These batteries of the first position being exposed to the heaviest fire, should have parapets 23 to 26 feet thick with shallow unrevetted embrasures.

Each battery should have two powder magazines.

Small defiladed depôts should be chosen near the batteries for such things as can be kept out of the latter. (p. 32.)

The first batteries should be armed with the heaviest guns in the train, and with a few field guns to resist sorties.

While the batteries are being made, and previous to the opening of fire, a good two days' supply of ammunition should be brought up. The lowest supply for one day (24 hours) is considered to be :—

60 rounds for each heavy gun.
80 rounds for each light gun.
40 rounds for each mortar. (p. 33.)

The artillery reliefs should be for 24 hours—an officer to be detailed for each battery, and eight to ten men per gun. The reliefs should be changed by degrees, and some hours before sunset. (p. 34.)

Night fire should be at irregular intervals. (p. 35.)

For the protection of the batteries of the first position small infantry emplacements between them are recommended. (p. 37.)

The first parallel, it is suggested, will be 656 to 765 yards from the salients. In some cases an intermediate position between the first batteries and the first parallel may be necessary.

For the security of exposed flanks of the first parallel, field-gun emplacements are recommended. The guns to be kept under cover except when required, when they should be run up on to raised platforms. Field batteries should be posted to flank the ends of the parallel. (p. 38.)

The approaches are made at the same time as the parallel. *After* the first parallel is made, and under protection of its musketry fire, the second artillery position is developed at from 656 to 1,640 yards from the salients. (p. 39.)

Enfilading batteries should be about 1,312 yards off, and behind natural cover.

The dismounting batteries at the same distance, and so as to fire at an angle with the parapet of more than 60 degrees. (p. 39.)

Curved fire batteries at not less than 820 yards. Mortar batteries at 1,531 to 1,640 yards from the works. (p. 40.)

Owing to the difficulty of getting up guns to the second position the lighter natures, such as the 4·7-inch* and short 5·9-inch* (15-c.) will be used. The use of heavy guns is exceptional; for instance, in case iron defences have to be breached. (p. 41.)

For the guns of the second position, provide 24 hours' supply of ammunition as follows, viz. :—

60 rounds for each heavy gun.
80 rounds for each medium gun.
40 rounds for each mortar. (p. 41.)

Aim throughout at impeding the movements of the defensive artillery.

From the first parallel an advance by zig-zags and saps is possible by keeping down the defensive fire. (p. 42.)

---

* In the English siege train the corresponding guns would be the 40-pr. of 35 cwt., and the 6·6-inch howitzer of 36 cwt.

Except as regards curved fire breaching the close attack is not much changed. (Note, p. 42.)

A second parallel will be formed at 328 to 437 yards, and demi-parallels at 131 to 164 yards from the salients.

A third parallel at 60 yards from the salients, *i.e.*, beyond the possible mine field. (p. 43.)

6-inch S.B. mortars, and sometimes field guns, are used from the second and demi-parallels. (p. 43.)

An early preparation of the breach is sometimes to be recommended, and also the making of several breaches. (p. 45.)

When the greatest drop does not exceed 1 in 4, curved fire batteries with the short 5·9-inch guns are used in rear of the first parallel.

The angle between the lines of fire and of revetment (angle of obliquity) to be not less than 60 degrees. (p. 45.)

Satisfactory results can only be secured by observing the effects of the fire. (p. 46.)

Failing other methods, a number of field guns on the covered way may be used to breach. (p. 46.)

The counterscarp must be blown in by mines. (p. 46.)

Attack salients so as to cover the passage of ditch. The breach to be at least 21 yards wide. (p. 49.)

For full revetments cut down to $\frac{2}{3}$rds of the height from the cordon.

For detached walls cut down to $\frac{3}{4}$ths of the height from the cordon. (p. 49.)

With a view to assault, and to avoid street fighting, the artillery of the attack bombard the buildings and the lines of retreat of the defence. (p. 49.)

Fire is classified as—

(1.) Direct. (2.) Indirect. (p. 51.)

(1.) Direct :—When the object is seen along the sights.

(2.) Indirect :—When the object is unseen with reference to the trajectory.

Fire with a flat trajectory is called *de plein fouet*, curved fire up to 45 degrees of elevation is called *plongeant*.

High-angle fire with angles of elevation of 45 degrees and over is called "vertical." (p. 52.)

The heavy guns intended for direct fire are unfit for curved fire, as their shooting is inaccurate with reduced charges; they should be used for direct fire only. (p. 53.)

Except from rifled mortars, the fire from the first artillery position is nearly always direct, (*i.e.*, full charges and sights are used.) (p. 53.)

The distance is such that the guns are not too exposed, and with howitzers fired with their full charges the drop is sufficiently searching for enfilading purposes.

For bombardment, however, nearly all the fire may be indirect.

From the second artillery position, direct fire for dismounting is recommended. (p. 55.)

With enfilade fire a low velocity is an advantage, because more splinters fly back from the burst. (p. 56.)

Battery look-out posts should be within speaking distance of the battery. (p. 56.)

Use also advanced observatories. (p. 57.)

In breaching from the counterscarp by the method of vertical and horizontal cuts, the horizontal cut measured from the bottom is to be $\frac{1}{3}$rd to $\frac{1}{2}$ the height of the wall. (p. 58.)

Another method is to have 3 horizontal cuts, the bottom (at $\frac{1}{3}$rd from the foot) having the least, and the top the greatest depth. This is said to be the best with counter-arches. (p. 60.)

Both these methods are applicable up to 1,313 yards with seen revetments.

In order not to lose 50 per cent. of the shots, fire at a point somewhat above the lowest point of impact, but with the maximum angle of descent required to reach the lowest point.

Thus in forming a horizontal cut, the mark should be a point at a height above the lowest point equal to the 50 per cent. vertical dispersion, as given in the tables. (p. 61.)

When the conditions are too difficult for a horizontal cut, batter the whole surface to be destroyed. (p. 63.)

One great advantage of observing the effects is that, after firing at the lower part with the maximum angle of drop, the charge may be increased so as to work up the face of the wall under better conditions. (p. 63.)

The minimum striking velocity is put at 492 feet a second (p. 64.)

For breaching, advantage should be taken of commanding sites (p. 65.)

The necessity for armour piercing shells for siege guns is urged in view of iron defences.

In any case, even field guns can fire shells at the embrasures of iron defences.

For breaching iron, 1,640 yards is about the greatest range, and the line of fire should be at right angles to the face. (p. 66.)

With a plated battery either try to batter the plates near the embrasures, or breach the masonry cover of the foot and strike the weak parts. This latter method is uncertain. Turrets are harder to deal with than plates. (p. 67.)

In the absence of direct penetrating power, either lay on the middle of the turret at the level of the embrasures and watch the rotation so as to fire at the embrasures, or try to jam the turning gear by debris at the foot. (p. 68.)

The formation of a breach in the covering mass at the foot is not thought very practicable. (p. 69.)

T.F.

PAPER XIV.

TARGETS

FOR THE

TRIAL OF RECENT HEAVY ORDNANCE.

PART IV.

By Colonel Inglis, R.E.

Compound Steel and Iron Armour Plates.

Although there has been no practice with guns of the heaviest natures against armoured structures since Part III. of this subject was written for Vol. I., yet as a good deal of experience has been gained in the interval in regard to steel and compound armour by practice with other guns, it is proposed to deal with this branch of the subject now, as far as it goes, without waiting for the more conclusive results which must sooner or later be obtained with larger targets and more powerful ordnance.

In case it should be thought that this investigation has at times assumed a somewhat desultory character, it may be well to explain that it is mainly due to the enterprise of the Sheffield Armour Plate Manufacturers that these trials have been made at all. These firms have at their own cost supplied nearly all the steel and compound plates which have been experimented upon at Shoeburyness during last year and this, and it is certainly due to the gentlemen managing the works of those firms to say that they have spared themselves neither trouble nor expense in following the thread of a very intricate enquiry in any direction in which there appeared to be the faintest hope of meeting with any success.

In the middle of December last (1877) some steel and iron plates of good size were tested by the Admiralty on board the "Nettle" at Portsmouth, which trials I should not have felt myself at liberty to notice here if it had not been that they were fully reported at the time in the newspapers.

Three of these plates were supplied by Messrs. C. Cammell and Co.; the fourth was one of Sir J. Whitworth's. All were 9 inches thick.

Of the three Sheffield plates one was of solid steel, with so low a percentage of carbon (0·13) that it was hoped it would not crack under the impact of shot. This plate was 9 feet 9 inches long and 7 feet 9 inches wide. The next was a compound plate consisting of 5 inches of hard steel (0·64 per cent. of carbon) on 4 inches of iron, and measured 9 feet 9 inches by 7 feet 2 inches. The third was a compound plate composed of $6\frac{1}{2}$ inches of hard steel (0·57 per cent. of carbon) with a face of $\frac{3}{4}$-inch iron and a back of $1\frac{3}{4}$-inch iron. This plate was not so large as the others, measuring only 8 feet long and 6 feet wide.

All the plates were bolted to a massive timber backing.

The gun used in these trials was the 9-inch 12-ton gun, firing Palliser shot, 250 lbs., (Mark III.), head struck with radius of $1\frac{1}{4}$ diameter, and charge of 50 lbs. pebble powder, at 30 feet range.

It may be mentioned that in order to get a standard of comparison a 9-inch plate of ordinary rolled iron armour had previously been tested on board the "Nettle," under precisely the same conditions as those of the present trial, and on that occasion one shot went through the plate, and two others, which entered it somewhat obliquely, failed to do so, raising a high bulge on the back without breaking off any of the back moulds.

The solid steel plate received three rounds, the head of the shot in each case remaining embedded in the plate, the bodies of course breaking up. In one case the head was afterwards knocked out, and the indent was found to be 7·7 inches deep. Two or three cracks, of greater or lesser extent, were formed by each shot; but on the whole the plate stood fairly well, and as regards penetration was much superior to the standard iron plate.

The compound plate, faced with five inches of hard steel, received only two rounds, as it was found that in the manufacture the steel had been completely spoilt, and it was useless to continue the trial. In both rounds the plate was pierced, and nine or ten cracks were formed in radial directions from the shot mark in the first round.

The other plate, a sandwich of steel between iron, received three shots. The first shot indented the plate 6·75 inches deep, its head remaining there embedded until afterwards knocked out. The plate was cracked through its full thickness on the top edge. The second shot remained with its head in the plate, so that the indent

could not be measured, but the head was very much injured. The third shot broke up small, but got through the plate and detached a piece of it at the right hand top corner. The hard steel of this plate was certainly too much for the Palliser shot to stand, but the plate was cracked a great deal, and hardly promised success for this kind of manufacture. It may be mentioned that the $\frac{3}{4}$-inch of iron on the face appeared to have been entirely converted into steel in the process of welding, and the same thing was observed in some degree in the back layer of iron.

The other plate to be noticed is that of Sir J. Whitworth's, which was of quite a novel kind.

It measured 6 feet 8 inches by 5 feet, and consisted of a mass of the Whitworth fluid compressed steel, 9 inches thick. The proportion of carbon contained in it is not known; but the steel is called by Sir J. Whitworth 40-ton steel, from the strength of a square inch of the metal being equal to a pull of 40 tons. Through this mass were drilled at regular intervals of about 9 inches from centre to centre all over the plate, a series of holes, $4\frac{3}{4}$ inches in diameter, into which were screwed plugs of steel (52 in all) of much harder and stronger quality than the rest of the plate. The steel of these plugs was called 100-ton steel.

The object of this method of construction was to make it impossible for the projectile to hit the plate without striking one or more of these hard plugs; and also, it was thought, that any cracks which might be set up in the plate by the blow of the projectile would stop at the nearest plug holes.

Sir J. Whitworth mentioned that he had intended that the steel of which the body of the plate was made should be tempered in oil, by which he thought its strength would have been largely increased, but this, from accidental circumstances, he was unable to carry out.

The plate was held to the backing by sixteen bolts screwed into the hard plugs.

The plate received three rounds; in the first of which the Palliser shot was completely broken up, leaving its head filling the indent. This was afterwards knocked out, when the indent was found to be only 4·1 inches deep. The plate was cracked more than was expected, and in one instance a crack was formed between two plugs, at a distance from the shot mark.

The next round gave an indent of only 2·85 inches in depth; but

it opened several fresh cracks through the plate, and enlarged those made by the first round.

The last shot struck with its point exactly upon one of the plugs, which it drove in to a depth of 6·16 inches, and by forming new cracks and enlarging previous fissures, it broke the plate up into four or five distinct pieces.

The general result may be said to be that the hard steel plugs undoubtedly resisted penetration in a remarkable way, by utterly breaking up the chilled iron heads of the projectiles; but the effect of the plug holes was certainly not to diminish the injuries to the plate by cracking; on the contrary, they assisted the breaking up of the plate.

Early in January of the present year Messrs. Cammell and Co. sent to Shoeburyness a compound plate, measuring 3 feet 5 inches by 3 feet 5 inches, and 9 inches thick, made up of a wrought iron plate 3 inches thick, with dovetails formed on its face, and steel cast on it while cold. There were three dovetails each way, $2\frac{1}{2}$ inches wide, $2\frac{1}{4}$ inches in neck, and 1 inch deep. The steel cracked through vertically of its own accord before it was fired at.

One service 7-inch Palliser shot (round 2361), fired with 30 lbs. pebble powder at 30 yards, broke the plate into fragments, seventy of which were counted.

At the same time another small plate, composed of a front of $4\frac{1}{2}$ inches of hard steel (0·45 carbon), welded to a back of $4\frac{1}{2}$ inches of mild steel (0·2 carbon), was broken (round 2362) into a number of pieces by a similar blow. The point of the shot, which was uninjured in this case, indented the plate to a depth of 4 inches.

After this, Messrs. Brown and Co. made a compound plate for trial at Shoeburyness, on the same plan as that described at the end of Paper XVIII., Vol. I., of this series (see p. 232).

In this case the plate was larger than the former one, and measured 7 feet 6 inches by 6 feet 10 inches by 9 inches in thickness. It was made up as before of a 4-inch steel front (0·5 carbon) upon a 5-inch iron back. It may be mentioned in addition to the former account of this method of manufacturing compound plates, that after the Bessemer steel has been run upon the iron armour the mass is allowed to cool down, and furnaced for pressing in the hydraulic press, where its thickness is reduced by about 3 inches, before being furnaced for the last time for final rolling.

It may also be mentioned that at first some difficulty was experienced in running the molten steel on to the iron armour, as

the force of the stream had the effect of actually sinking a hole through the plate where it impinged. This has now been met by dividing the stream into a number of smaller jets, which fall upon the plate through separate openings some little distance apart.

The plate was tried without backing, and first received three rounds (2363 to 2365) from 7-inch Palliser shot, fired with 30 lbs. pebble powder at 30 yards distance, and planted about 2 feet from centre to centre. The indents were respectively 7·22 inches, 5·35 inches, and 6·25 inches deep, and slight bulges with surface cracks on them were formed on the back of the plate. The points of the shot remained entire from 2 inches to 6 inches in length, but the rest broke up small and was splashed. The steel face was a good deal cracked by the first and second shot, but the cracks were confined to the steel, and the steel remained perfectly united to the iron back.

Soon afterwards the same plate was reversed, that is, it presented the iron face to the front, and a round (2366) exactly corresponding with the three former rounds was fired at it. This time the shot broke a hole quite through the plate, and the front part of it remained sticking there with its head quite uninjured shewing to the rear, the point being 7·8 inches from the front of the plate. The steel at the back was broken away round the shot mark, over an area of about 2 feet by 1 foot, to a greatest depth of 4·6 inches. The cracks formed in the steel by the first three rounds were much enlarged, and others were newly formed. Still the steel and iron held well together, and the cracks in the steel, with one exception, did not extend into the iron.

The same plate next received a round (2368) from a service 9-inch Palliser shot, fired with 50 lbs. pebble powder at 44 yards, the steel face having been turned again to the front. The head of the shot, very finely broken up, remained in the plate, and the face of the plate was much scored by the fragments of the body of the shot. On a subsequent occasion the head of this shot was shaken out, and the indent measured $10\frac{1}{2}$ inches in depth; the head being found to be broken in very small pieces except the extreme point, which was whole for a length of 2 inches by $3\frac{3}{4}$ inches. The bulge raised on the wrought iron back of the plate was 3·7 inches high, and there were cracks upon the bulge gaping $2\frac{1}{2}$ inches. This is somewhat more effect than the same round would have had upon a good 12-inch rolled iron armour plate.

Before leaving this plate, which on the whole may be considered

a successful piece of manufacture, I should like to mention a trial which gave an interesting, and what may perhaps turn out to be a very important, result.

On observing carefully the effect upon the shot in the round (2366), when the steel face of this plate was turned to the rear, it occurred to Capt. English that the wrought iron, through which the shot had to pass to reach the steel, had operated in favour of the shot by forming a cushion, as it were, between the chilled iron and the steel, and so saved the head of the shot from being broken up small, as it usually is, on coming in contact with steel. From this he inferred that if in any case a small thickness of wrought iron were to be interposed between a chilled shot and a steel face, the projectile would hold together and do more work than it would if the steel were first encountered.

To put this to the test the same compound plate of Messrs. Brown and Co., was set up with its steel face to the front, and this time, (round 2377), a small piece of old $2\frac{1}{2}$-inch plate was placed in front of it touching its steel face. The shot used was the 9-inch Palliser of the service, as in round 2368, with the same charge, and the result was most remarkable.

Instead of the chilled head being broken as usual into minute pieces on striking the steel plate, it behaved exactly as if the whole target had been of soft wrought iron. The head remained entire for a length of 10 inches, and the body broke only into large pieces. Compare this with the head in round 2368.

The front $2\frac{1}{2}$-inch plate was broken into several pieces, and the injury on the back of the compound plate was certainly greater than in round 2368, when it stood alone. In this case the bulge raised on the back was 8·7 inches high with cracks gaping $4\frac{1}{2}$ inches, and a through hole measuring 4 inches by $1\frac{1}{2}$ inches against a bulge 3·7 inches high and cracks gaping $2\frac{1}{2}$ inches before; perhaps, however, a slight allowance should be made on account of previous injuries to the plate near the present shot mark. But the most noticeable feature of this round was the remarkable cleanness of the hole formed in the steel of the plate. It had all the appearance of a punched hole. Its diameter was exactly that of the shot, and its edge was perfectly sharp and square without the slightest approach to either a lip or dish being formed, or any signs of the metal having been forced sideways. There was no lip on the front of the $2\frac{1}{2}$-inch plate, but it was observed that all round the shot hole on the back of this plate an annulus of metal had been raised about $\frac{1}{2}$ inch high and 3 inches wide.

Altogether this is considered an important round, as closely affecting the question of using steel armour.

Proceeding still further in the same direction, it was next considered whether a similar result could not be produced by making a cap of wrought iron fitted on the head of a chilled projectile act the part of the $2\frac{1}{2}$-inch plate in this trial.

Accordingly a 9-inch Palliser shot, of the same pattern as before, was fitted with a wrought iron cap, which had a flat nose $2\frac{1}{2}$ inches in diameter, and a thickness of $2\frac{1}{4}$ inches between the point of the shot and this flat nose. The cap wrapped round the head of the shot as far as the extractor holes, into which two steel plugs were set to prevent the cap from slipping. It weighed about 28 lbs.

After the six rounds which this compound plate had already received (it had been also slightly injured by an accidental round not recorded here), there was scarcely room upon it for the trial of this capped shot. It was fired on the 28th May, number of round 2412, with the same charge as before; but as the cap made the shot weigh heavier than in round 2377, there was a little loss of velocity.

Having to aim rather too near the edges of the plate a corner of it was broken off it into several pieces, but on putting them together there was unmistakeable indications of the shot having acted as it did in round 2377; that is, of its having made a clean hole through the steel without the head being broken small. In this case the head, found after the round, measured from $6\frac{1}{2}$ to $7\frac{1}{2}$ inches in length, but the point about 3 inches long, still quite sharp, had been detached from it.

Although, from the circumstances of this round, it cannot be considered altogether a decisive one, still the result is so important that the matter cannot rest here.

As it would be making this account unnecessarily tedious if I were to notice in detail all the other trials of steel and compound plates that have been made during the period between January and July of the present year, a short general description of the principal results will only be given.

An attempt by Messrs. Cammell to make another 9-inch plate of a sandwich Bessemer steel between wrought iron plates about 2 inches thick, gave even less satisfactory results than in the trial at Portsmouth, as already mentioned.

Another 9-inch plate by the same makers, composed of a number of mild steel (0·2 carbon) moulds rolled together, let the chilled

shot pass through too easily, though the head was broken into small pieces.

The steel in the fractures of the plate had all the appearance of being wrought iron.

Another compound 9-inch plate of Messrs. Cammell's, made of 5 inches of steel (0·38 carbon) on 4 inches of iron, completely demolished the chilled shot. The steel was cracked, but not the iron back. The effect on the back of the plate was slight.

The same makers also sent the following:—A 9-inch plate composed of $3\frac{1}{2}$ inches of hard iron welded to a back of ordinary soft iron armour; but the iron was not hard enough to break up the chilled head of the shot. Also one composed of 5 inches of soft iron, sandwiched between a front and back of 2 inches of hard iron, which let the shot through easily. A homogeneous steel plate (0·2 carbon) tempered in water, which broke up into five large and several small pieces, though the shot did not indent it deeply. In the fractures of this plate was found water, which had got there in the process of tempering, and which shows, I suppose, that the mass underwent some separation of its particles in the operation. A 9-inch compound plate of 6 inches of steel (0·3 carbon) welded by casting to 3 inches of iron back, which broke in two, and showed that in parts the iron had been converted into steel; but the union of the steel and iron was very complete. A mild steel (0·17 carbon) plate, tempered in water, was also compared with one tempered in oil; but on this occasion there was not much advantage apparently gained by the oil tempering, though it gave the steel a very good appearance.

Messrs. Cammell sent also other compound plates, in one of which the face of steel was only 3 inches thick, which proved quite sufficient to break up the chilled head of the shot.

Before leaving Messrs. Cammell's manufacture, it may be mentioned that they sent also a compound plate in which $3\frac{1}{2}$ inches of hard steel (0·7 carbon) was joined to $5\frac{1}{2}$ inches of iron by a kind of brazing process. The steel face was swept clean off by the shot and was broken to pieces, but still it had the effect of breaking the head of the shot into small pieces, and the effect on the back of the plate was small.

In the course of the same period, Messrs. Brown and Co., sent for trial a set of 5-inch Bessemer steel (0·3 carbon) plates hammered and rolled, and tempered as follows:—

One was hardened in water, and it broke up easily.

The next was annealed, and it also broke into four pieces too easily.

The third was tempered in oil, and stood without any cracking a blow equal to that which had broken up the other two plates. A second round at the same plate knocked a corner of it off, and set up a crack through the former shot mark, but the plate was a small one for two rounds. It may be mentioned that the blows given to this set of steel plates were the same as those always given in the proof 5-inch iron plates, that is, they were struck by service Palliser 7-inch shot, fired with $8\frac{1}{2}$lbs. R.L.G. powder at 30 yards, and a good proof plate stops this shot with an indent of about $6\frac{3}{4}$ inches, and a bulge with a star crack upon it more or less gaping. Also, often, or rather generally, some of the back mould of the plate is knocked off the bulge.

The indent in the oil-tempered plate of this set was only 4·55 inches deep, and the bulge on the back was not an inch high, and there were no cracks upon it.

Another oil-tempered steel plate was tried about the same time, and the corresponding indent made in it was only 3·45 inches deep, but the plate had flaws in it, and it broke in two.

From this it may be laid down that the oil-tempered 5-inch Bessemer steel plate was equal as regards resistance to penetration to an ordinary iron armour plate of good quality, about seven inches thick. The comparative value of the material as regards general endurance under shot blows is another matter, which cannot be determined in so small an experiment.

This firm also tried the effect of hardening in oil a compound plate, using for the purpose a piece cut from a 9-inch plate which had been tried at Portsmouth. The indent produced by a 7-inch shot, with 30 lbs. pebble powder at 30 yards, was 5·4 inches deep; but on a prevous occasion, already mentioned, a corresponding round gave an indent of 5·35 inches, so there was no gain as regards penetration, and on the whole it was thought that the oil hardening had not had much effect in any way upon the plate.

One other compound plate made by Messrs. Brown, and tried at Shoeburyness, must be noticed before leaving this part of the subject, more for the sake of shewing how perseveringly these trials have been made, than on account of the value of the information derived from the experiment.

This was a 9-inch plate, measuring 6 feet 9 inches by 5 feet 5 inches, and consisted of a back of wrought iron 3·7 inches thick

and a Bessemer steel front, making up the rest of the thickness, run round a number of hard steel plugs $6\frac{3}{4}$ inches in diameter, with grooves and rings cast on them, placed from $9\frac{3}{4}$ inches to $10\frac{1}{2}$ inches from centre to centre. For running the steel on to the wrought iron forming the back of the plate a frame was used, as on former occasions already mentioned, and usually the steel thus run becomes thoroughly united to the wrought iron, but in this instance, whether from the hard steel plugs taking up some of the heat of the steel, or from some other causes, there was no real union either of the body of the steel, or of the steel plugs, with the wrought iron, and the plate was a lamentable failure. Besides the want of weld, the steel was also completely spoilt, and a 9-inch shot which would have been easily stopped by an ordinary compound plate of this thickness went through the entire mass, completely separating the steel front from the iron back, and breaking it up. The fact of this plate not having been either rolled or hammered after the casting of the steel is in my opinion enough, and more than enough, to account for its failure under shot blows, but there were other obvious and fatal defects in the manufacture.

Some of the plates mentioned above were prepared as test pieces to guide the manufacture of certain plates for Admiralty trials at Portsmouth, but as these plates, though larger than those we tried at Shoeburyness, gave on the whole much the same results as ours did, it is not proposed to notice them here.

At this point, two rounds with steel shot were fired at a steel-faced plate, which have so important a bearing on the subject of this paper, that they must not be altogether omitted, though, as they form part of an extensive series of trials which are still in progress under a special Committee, they can be only briefly noticed.

So far as I am aware, this is the first time that steel projectiles have been fired at steel armour, at any rate, in this country, and in a trial upon anything like a satisfactory scale.

In the present case the gun used was the service 9-inch gun at 50 yards range. The shell including the gas check weighed 268lbs., and no bursting charges were used. The projectiles were in form the same as the service Palliser. (Mark IV.)

The plate was a compound plate of a total thickness of 10 inches, composed of a face of 4 inches of Bessemer steel, on a back of 6 inches of ordinary soft iron armour, and it was made in the same way as the 9-inch compound plate described earlier in this paper. The plate was unbacked, and unsupported.

In the first round (2133) a shell of the Whitworth fluid compressed steel, forged, bored out of the solid, and turned, struck the plate with a velocity of 1490 feet per second, and indented it to a depth of $10\frac{1}{2}$ inches, making a considerable star crack at the back. The shell itself was set up in length from 21·26 inches to 18·6 inches, its diameter was increased by a little more than an inch, and it was cracked through all its front stud holes. The steel face of the plate was cracked, but the steel adhered to the iron back which stood well.

The other round (2136) was fired with a cast steel shell made by Messrs Cammell, of very fine quality, arrived at after several experiments, but the details of manufacture are not at present known. This much, however, may be said of it, that being a simple casting the cost of it must, after making due allowance for the skill and care necessary in making and tempering, be small in comparison with the forged steel shell used in round 2133.

The shell struck the same compound plate with a velocity of about 1480 feet per second, and went completely through it, the head being broken in three pieces, and the body broken, but not into small pieces. The steel face was cracked more or less, but still the steel adhered to the iron back.

In comparison with these two rounds, a chilled iron shell made, of an improved manufacture, by the Royal Laboratory Department, was next fired at the same plate, but, as on former occasions, the chilled iron was unequal to stand the blow against the steel, and broke all to pieces, merely forming a slight bulge with a crack upon it on the back of the plate.

The lesson to be drawn from this experiment is of some importance, as it shews that steel projectiles can be made that will pierce, without being much injured themselves, steel, which, if not of the hardest nature, is at any rate hard enough to break up completely the hardest chilled cast-iron projectiles. More than this cannot be said at present on the subject of compound plates.

With regard to ordinary iron armour, it is scarcely necessary to say that the steel shells which have given such good results on steel faced plates maintain a considerable superiority over chilled cast-iron projectiles in attacking soft wrought-iron plates. An exact measure of this superiority can scarcely be given at present, but it may be said roughly that while the best 9-inch steel shell will completely perforate a 12-inch iron plate, a service Palliser shell with the same velocity will only raise a bulge about 4 inches high on the back of

the same plate, with a star crack on the bulge, perhaps, just deep enough to shew daylight through.

It is also satisfactory to find, from an extensive series of competitive trials which have recently taken place at Shoeburyness, that we can make battering projectiles in England which are vastly superior to any hitherto made by the continental manufacturers.

Speaking in general terms of the results which have been obtained in the above trials during the last six months, it may be safely said, I think, that the compound plate having a moderate thickness of steel on the front side has done much better than the plate made wholly of steel, and this would, in all probability, hold good whether chilled cast iron or steel projectiles were used against them.

Whether, by any improvement in the manufacture of steel or iron plates, or by introducing some new method of combining steel and iron armour, a material can be produced, which, while sufficiently hard, shall be more free from liability to crack under shot blows than the hard plates hitherto tried, remains yet a matter for further investigation, and, so far, at any rate, as floating structures are concerned, it is a very important matter. But with the result obtained in round 2136 before us, it must be admitted that the problem is an exceedingly difficult one. For, unless the steel be hard enough to demolish the head of the projectile, the gain of resistance will be very limited, and that round certainly shows that a good steel head is not to be easily broken up, while, on the other hand, the harder the steel plate is made, the more difficult is it to provide against cracking under sudden blows.

The investigation will, of course, not be complete until the steel surfaces have been tried with heavier guns than those hitherto used in these experiments, and with projectiles of the best material, and perhaps, of improved form, striking with the very high velocities which are now being obtainable, and also, with projectiles of various forms striking obliquely.

These and many other points will be brought out in the course of trials which are about to be undertaken, and I shall, therefore, hope to resume the subject on a future occasion.

Armour Plates with void spaces between them.

In speaking of the trials of void space targets in Paper XVIII., Vol. I., of this series, one of the reasons given for attaching only slight importance to the singular results obtained with the chilled

iron projectiles used against them was that of its being more than likely that other kinds of projectiles could be found which would pierce these structures without breaking up in the head, and if that could be done, instead of additional security being obtained, the separation of the plates without the spaces between them being filled would be a source of weakness, and of no practical advantage.

To set this point at rest a target was set up at Shoeburyness, consisting of two 2-inch plates touching each other, with a blank space of 4 feet 6 inches behind them, and then an 8-inch armour plate.

A 9-inch cast steel shell, of a quality of steel which had on former occasions proved itself only moderately good for battering purposes, striking this target with a velocity of 1,500 feet a second, passed completely through it; whereas, a service Palliser projectile of the same form, and striking with the same velocity, completely gave way on meeting with the 8-inch plate, and its head was found sticking in that plate broken into minute pieces as usual. It is believed that the steel shell broke up in the body, but there was no indication of its having done so before it had almost completed its work upon the target. So far as this trial went, therefore, our suspicions as to the performance of steel projectiles were fully confirmed.

But, before closing the trials, it was thought desirable to ascertain whether, by any means at all, a steel projectile could be defeated by air spacing, and the last target was re-arranged in such a manner, that the front thickness of two 2-inch plates was inclined so that their face was at an angle of 30° with the normal position, that is the angle of incidence of the shot was 60°. Behind these front plates there was the same blank space of 4 feet 6 inches, and then the 8-inch armour plate square as before with the gun.

This time a cast steel 9-inch shell of a good deal better quality than the last, struck with nearly the same velocity as before, but failed to get through the target, though its head remained pretty perfect; and there was no indication of the action upon it, which would have been set up in a chilled iron head.

Subsequently, a very superior forged steel shell of the same calibre, and striking with about the same velocity, completely pierced this target when its front plates were inclined as on the last occasion. In doing this the shell was so far thrown off its balance by the front plates, the proper right end of which retired, that it passed through the 8-inch plate at an inclination to its own right of about 20° from the direct or perpendicular line, but still with all the extra strain thus thrown upon the shell it remained entire,

except as regards the very point of the head, which had, for manufacturing purposes, been inserted as a plug, and which was knocked off; there were no signs whatever of the steel giving way under the double shock due to the void spacing.

After results so clear and conclusive, it was thought unnecessary to proceed further with the trials, and I am afraid a verdict must be given against the principle of void spacing for structures liable to attack by steel projectiles.

Increasing Power of Heavy Ordnance.

It may be useful, before closing this Paper, to say a few words on the subject of an increase which is taking place in the power of heavy guns, and of the effect which this is likely to have upon works of coast defence.

It is well known that the tendency of late years has been to substitute for the violent powder of former times one of less rapid and more uniform ignition, and that so, first the pellet and then the pebble form of grain came to be introduced into the service, superseding the old R.L.G. powder. Following up this improvement some countries adopted prismatic and other forms of grain; but in this country the cubical shape has had the preference for heavy guns.

Combined with this advance, much attention has been devoted to the question of further reducing the violence of first expansion by giving to the charge in the gun more than the cubical space it actually requires for itself.

The best way of gaining this additional space for the charge in any given gun, is to enlarge the diameter of the powder chamber; but where this may not be done, increased length of bore must be devoted to the charge.

The space thus given to the charge varies, according to circumstances. With Woolwich guns and cubical powder the most suitable amount of space is from 30 to 35 cubic inches per lb. of powder. When rammed up hard cubical powder occupies 24·6 cubic inches. Pebble powder occupies 27·7 cubic inches.

Without entering into the particulars of this subject, it may be said at once that, by the means above intimated, it has been found practicable to use in the guns of the service much larger charges of powder than those formerly used, and to obtain with them considerably higher velocities in the projectiles, with not only no greater

bursting strain upon the gun, but with these strains actually much reduced.

Of course there will be a wasteful use of powder with these increased charges in the present guns; and this points to the necessity of having longer guns, which is a matter now receiving some of the attention which it deserves, and which will no doubt in time lead to still further advances in the power of heavy ordnance.

Already Sir W. Armstrong has produced a gun of 6-inch calibre and 3 tons weight, which throws a projectile of 70 lbs., with the enormous velocity of 2000 feet per second. It is understood also, that he has a gun of 8-inch calibre and $11\frac{1}{2}$ tons weight, which throws a projectile of 180 lbs. with the same velocity.

The practical results of all this, as affecting armoured structures, may be seen in the following facts :—

Taking first the 9-inch 12-ton gun, which formerly fired a charge of 50 lbs. pebble powder, and gave an initial velocity to its 250 lbs. projectile of about 1,420 feet a second, a 75 lbs. charge of P2 (or $1\frac{1}{2}$-inch cube) powder is likely to be used with this gun, increasing the initial velocity of the projectle to something like 1,630 feet per second. The thickness of unbacked solid armour which this gun was calculated to piercebe fore with its Palliser projectile was $10\frac{1}{2}$ inches at the muzzle, but now it will pierce 12 inches at the muzzle, and $10\frac{1}{2}$ inches at upwards of 1,000 yards range.

Similarly with the 10-inch 18-ton gun, which fired 70 lbs. of pebble powder, and with its 400 lb. projectile at a velocity of about 1,360 feet, could pierce 12 inches of armour at the muzzle, but which can fire with equal safety 100 lbs. of P2 powder, and with a velocity of 200 feet per second higher will pierce with its Palliser projectile perhaps $13\frac{1}{2}$ inches of armour at the muzzle, or 12 inches at 1,500 yards range.

The 11-inch gun of 25 tons, which before could pierce 13 inches of armour at the muzzle, will now do the same at 1,000 yards; and the 12-inch 35-ton gun, which could pierce 14 inches of armour at the muzzle, will now pierce 15 inches at the muzzle, and 14 inches at about 1,000 yards.

All the above increase of power is obtainable without any alteration to the gun; and the service carriages and platforms are supposed to be strong enough as they are. It should be observed that a slight part of the increase of velocity gained in the above guns is

due to the closing of all the windage by the use of the gas checks, which have been lately introduced.

Next coming to the 12½-inch 38-ton gun, without any alteration, this, which had a charge of 130 lbs. P2 powder, giving a muzzle velocity to its 800 lbs. projectile of 1,420 feet a second, which was equal to pierce 17 inches of armour at the muzzle, is now found to be able to fire safely 160 lbs. P2 powder, giving an additional velocity of about 60 feet a second, and an additional perforation of about ¾ inch; but by chambering the gun a charge of 200 lbs. of P2 powder may be fired in it; and with this a muzzle velocity of 1,580 feet is expected, which would allow the projectile to pierce some 19 inches of solid armour at the muzzle, and 17 inches at nearly 1,500 yards.

As regards our 80-ton gun, no alteration is at present proposed to this; so the power of the four guns in H.M.S. "Inflexible," and of the two which are being made for the turret which is nearly ready for Dover Pier, will be that deduced from the results of the trial of one of them when in its chambered state against No. 41 target, as reported in Part II. of this subject, Vol. I. of this Series. In other words they will, at the muzzle, pierce about 23 inches of solid unbacked armour; at 1,000 yards, 22 inches; at 1,500 yards, 21 inches; and at 2,000 yards, about 20 inches.

As regards the only larger gun in existence, namely, the 100-ton gun, made by the Elswick Company, of which our government have lately purchased four, it is understood that since the trials of one of these guns at Spezia in 1876, as briefly reported in Part II. of this subject (Vol. I.), the gun has been chambered, and that now it can give a muzzle velocity to its 2,000 lbs. projectile of 1,700 feet per second instead of about 1,545 feet before, representing an increase of *vis viva* in the shot at the muzzle from about 33,000 to 40,000 foot tons, and a power to pierce, perhaps, 26 inches of solid wrought iron armour at the muzzle, instead of 24 inches formerly.

Lastly, it must not be forgotten that there is still another source from which a considerable gain of battering power may be reasonably expected, namely—in the improvement of the projectiles in regard to both material and form, and also possibly by the use of guncotton, or other more violent explosives as bursting charges.

Experiments are still proceeding in this direction, and enough has been said above to shew that the investigation may lead to very important results.

1*st August*, 1878. T.I.

P.S.—Since writing the above account the 6-inch Armstrong gun, which I have mentioned, has been tried against armour plates at Shoeburyness, and the results obtained with it are of sufficient importance to make it desirable that they should be known at once.

The practice took place on the 24th of September.

For the trial Sir W. Armstrong and Co. provided some steel and some chilled iron projectiles. In external form they resembled the battering shells of the service, except that, as they were rotated in the gun by means of their gas checks they had no studs, and, as the gun is a breechloader, there were no extractor holes in the shells. The advantage of being able to dispense with these sources of weakness in battering projectiles is not a slight one.

The steel shells were made of Whitworth fluid compressed steel, forged, bored, turned on the outside, and tempered. The chilled shell were similar as regards manufacture to the Palliser shells in the service. None of the shells had bursting charges.

The gun was placed at about 85 yards from the plates.

The following rounds were fired :—

Round 2146.—In this a steel shell, weighing 84lbs. with its gas check, was fired with a charge of 33lbs. P. powder, and struck a 10-inch wrought iron armour plate (exact thickness of plate 9·85 inches) with a velocity of about 1780 feet per second. It passed clean through it, and 9 feet into an earthen butt in rear. When dug out the shell was found to be unbroken, and indeed to all appearances uninjured. Its diameter was not increased by more than 0·02 inch. Its gas check was still attached to it.

The plate was of good quality, and it is probable that it would have been perforated in this round, even if it had been from $10\frac{1}{2}$ to 11 inches thick.

Round 2147.—In this a similar steel shell, fired with 36lbs. of P. powder, struck a 13-inch wrought iron armour plate with a velocity of 1875 feet per second, but, either from want of uniform hardness in its head, or from some other cause, it turned slightly (about 13°) on entering the armour, and the indent measured in the direction of the axis of the shell was 9·65 inches deep. The shell rebounded about 24 yards, and when picked up its point was found to be slightly turned to one side, and there was a crack up one side of the shell. On the back of the plate there was a bulge ·95 inch high, with a crack upon it gaping ·4 inch.

Round 2148.—This time a chilled iron shell, weighing 80lbs., was fired with 33lbs. of P. powder, and struck the plate (9·85 inch)

that was used in round 2146 with a velocity of about 1807 feet per second. This also completely perforated the plate, and passed into the earth butt. The body of the shell broke up, but the head was entire except that a small piece of the point was broken off.

The equality of work done by this and the steel shell in round 2146, notwithstanding that the one broke up and the other remained entire, shows how little energy is expended in the breaking up of a cast iron projectile.

Round 2149.—A chilled shell, similar to that in the last round, was this time fired with 36lbs. P. powder, at a 12-inch wrought iron plate. It struck with a velocity of about 1,907 feet per second, and formed an indent 11·3 inches deep. On the back of the plate a bulge, $\frac{3}{4}$-inch high, was formed, and a crack opened with a gape of 1 inch. The body of the shell broke into large pieces, but the head remained entire.

Here then we have a 6-inch gun, which weighs only 3 tons, 18 cwt. throwing, with very moderate strains on itself, a projectile which perforates, with ease, a 10-inch armour plate, and which, with the increased charge used in two of the rounds fired in these trials, could, no doubt, pierce upwards of 11 inches of armour.

Considering that this amount of perforation is more than equal to that obtained with our 9-inch 12-ton gun, with its present service charge, and nearly equal to what is anticipated with the increased charges proposed for it in future, it must be admitted that this new gun threatens a complete revolution in the service and practice of gunnery, the full effect of which, as regards either attack or defence, it is impossible for any one at present to foresee.

It may be mentioned, though not with the object of unduly attributing the success of this gun to the fact of its being a breech-loader, that the breech mechanism is very simple, easy to work, and thoroughly effective.

T. I.

2nd October, 1878.

PAPER XV.

SOME RECENT

DEVELOPMENTS OF APPLIED SCIENCE,

Illustrated by the Phonograph and other Apparatus.

A Lecture delivered at the R. E. Institute 14th March, 1878,

By Lieut.-Col. Frank Bolton, *Hon. Sec. of the Society of Telegraph Engineers*,
and
W. H. Preece, Esq., C.E., *Vice-President of the Society of Telegraph Engineers*.

Lieut.-Col. Frank Bolton: At the meeting of the Society of Telegraph Engineers, which was held in London on the 27th February, some recent scientific inventions were exhibited and explained, which proved to be very attractive to the audience; and the particulars of the meeting having been mentioned to the Commandant of the School of Military Engineering, I was, in my capacity of Honorary Secretary of the Society of Telegraph Engineers, honoured by an invitation from Colonel Sir John Stokes to arrange for these inventions being shown to the Royal Engineers in this Theatre, and for a description of them being given, as they were likely to be interesting to the Corps, on account of the practical military purposes to which they might be applied. Having consulted with Mr. W. H. Preece, a Vice-President of the Society of Telegraph Engineers, and having secured his cordial and able co-operation, we jointly arranged a programme for this occasion, and trust that, in carrying it out, we shall conduce not only to your instruction but to your amusement.

The principal objects, to which we would draw your attention this afternoon, are:—

The Byrne's Pneumatic Battery, the Telephone, and the Phonograph; but, before these recent developments of applied science are described to you by the gentleman who will follow me, it may, perhaps, not be out of place to glance at the progress made in Telegraph Engineering and Electrical Science during the last few months.

The time at our disposal will not admit of any reference being made to the subject of Duplex and Quadruplex Telegraphy, beyond remarking that it is now occupying the attention of Telegraph Engineers, and its introduction, for the practical working of lines, is being attended with very satisfactory results.

The quadruplex system, for instance, continues to be worked between London and Liverpool, and it has quite quadrupled the power of the one wire to carry messages, and about 200 messages have frequently being transmitted in one hour.

The system of duplexing automatic circuits is gradually extending, and on the Leicester wire, which carried the Queen's Speech at the rate of 179 words per minute, messages were being transmitted in the opposite direction by the duplex arrangement at the same time.

Electricity has hitherto rendered service as the swift agency by which our thoughts are flashed to great distances, but it is gradually asserting its right also as a means of accomplishing results where the exertion of quantitative effects are required.

Dr. C. Wm. Siemens, in his Presidential Address to the Society of Telegraph Engineers (of which he is President this year), most ably reviewed the present progress of Electrical Science, and informed us amongst other things that, by an ingenious combination of two magneto-electric machines with Siemens' armatures, Mr. Wylde, of Manchester, had succeeded in greatly augmenting the effects produced; but the greatest impulse in this direction was given by the introduction of the dynamo-electrical principle, which enables us to accumulate the current active in the electric circuit to the utmost extent permissible by the conductive capacity of the wire employed. A machine weighing not more than 3 cwt. is capable of producing a light equal to 1,250 candle power, per horse power expenditure of mechanical energy; and we may assume, that each horse power can be maintained with an expenditure of 3 lbs. of coal per hour, which is a somewhat excessive estimate, while, for comparison, I may mention that the same amount of light would be produced by 139 cubic feet of gas of 18-candle power, for the production of which 30 pounds of coal are consumed.

For lighthouses, for military purposes, and for the illumination of large works and public buildings, the electric light has already made steady progress. The complete realization of all the advantages of the electric light remains, however, a problem to be solved.

The dynamo-electric machine has also been applied with considerable success to metallurgical processes, such as the precipitation of copper in what is termed the wet process of smelting. The effect of 1-horse power expended in driving a dynamo-electric machine of suitable construction is to precipitate 1,120 pounds of copper per 24 hours, equivalent to an expenditure of 72 pounds of coal, taking a consumption of 3 lbs. of coal per horse power, per hour.

Another application of the dynamo-electric current is that of conveying mechanical power, especially the power of such natural resources as waterfalls, to distant places, where such power may find useful application.

Experiments have also been made with a view to ascertain the percentage of power that may thus be utilized at a distance ; and the results of these experiments are decidedly favourable for such an application of the electrical conductor. It has been proved that above 40 per cent. of the power expended at the distant place may be recovered. The 60 per cent. wasted in transmission includes that lost in overcoming the friction of both the dynamo-electric and electromotive engines, the resistance of the conductor, and the power sustained in effecting the double conversion.

Several new forms of batteries have been under consideration, some of which promise to be of great value, notably Mr. De La Rue's Chloride of Silver Battery and Dr. Byrne's Pneumatic Battery.

In De La Rue's Battery the cells are composed of fused chloride of silver, or "horn silver" as it is called, for the negative element. The chloride is cast into cylinders about one-third of an inch in diameter and $2\frac{1}{4}$ inches long, with a length of flattened silver wire fused into the centre throughout their length—their weight is about 200 grains. The cell is of glass, one inch in diameter and $5\frac{1}{2}$ inches high, and the wire passes by the side of the cork or stopper, and reaches to the bottom of the cell. The rod of chloride is protected from contact with the zinc element by a sleeve or tube of parchment paper, sewed with thread, which surrounds it, but it is very essential that even this paper should not touch the zinc element, which is simply a small rod of zinc passing through the stopper, and reaching to the bottom of the cell. The stopper is made of paraffin wax. The solution used is composed of about 200 grains of chloride of ammonium to the pint of water. The battery has a resistance of from three to four ohms, but after a time oxychloride of zinc becomes deposited on the zinc element, and increases the resistance greatly—sometimes to as much as 30 or 40 ohms; it is,

however, readily removed by placing it in water acidulated with one-fiftieth of its weight of hydrochloric acid, or by adding a minute quantity of acid to each cell. This battery has no local action, and its durability is very great.

Byrne's Battery has recently been introduced from America, and I will now call upon Mr. Edmunds, who is Dr. Byrne's agent in this country, to describe it to you.

Mr. Edmunds: Dr. Byrne, of Brooklyn, had been wanting a battery for cautery purposes. What he wished to do was to heat platinum wire of certain lengths to a red heat, and to keep it hot for a certain length of time for surgical purposes, and he could not find anything that answered his purpose. So, to use his own words, he began to look out for himself, and proceeded to reduce the resistance of the negative element of platinum by backing it up with plate copper. Then, on injecting air through the battery, he depolarized the liquid and got the most wonderful effects in the circuit, which I will now show you.

The battery itself is a simple cell of platinum and zinc, excited by a mixture of 12 ounces of bichromate of potash with one pint of sulphuric acid and five pints of water.

Batteries of this form are well known, but the peculiarity of this battery is, in the first place, the negative plate is compound; the platinum plate is furnished with a backing of copper, from which it is separated by sheet lead, to improve the conductivity of the plate. In the second place air is pumped into it, in fact it is a pneumatic battery, and during the time of action a small air-pump forces the air through the liquid, stirring it up actively. There are 10 cells, and these are connected with two brass standards, which are connected together by a piece of No. 14 platinum wire. When the air is pumped the wire gradually gets heated to an intense degree, and on ceasing to pump it gradually cools down; and on pumping again the heat gradually accumulates.

There are here 30 inches of No. 14 gauge platinum wire, and I do not think any one here present has ever seen so thick a piece of platinum wire made hot by any battery. When using 70 or 80 Groves' cells 18 or 24 gauge wire is generally used. You see the great heat that this battery excites. There is nothing that can more indicate the enormous strength of the current produced by it; but not only has this platinum wire been made red hot, but these No. 10 gauge copper wires used as connecting pieces are so

hot that I cannot hold them. No doubt if the connecting wires were thicker the heat would have been greater in the platinum wire.

This battery was introduced for medical purposes—for cauterising; an interesting case of which has been recently performed in London by means of it.

I will now connect the battery with two carbon points, and the brilliant light which it produces by the incandescence of the carbons will show you the enormous strength of the current.

Lieut.-Colonel Frank Bolton: As I was about to remark before I called upon Mr. Edmunds to show you his experiments, the great telegraphic novelty of the day is the Speaking Telephone,—the popular exhibitions of which, together with numerous newspaper articles, have created a widespread interest in the instrument, and it is consequently now well known. I have, however, been requested to give a brief description of the telephone this afternoon, as there may, perhaps, be some present who have not had the opportunity of seeing it.

This remarkable instrument owes its origin to the labours of several inventors, but the beautiful and simple telephone of Professor Graham Bell, of the United States of America, must be regarded as a vast step in advance of all previous attempts in the same direction.

In all probability, the telephone is as much in its infancy as was ordinary telegraphy in 1840. Since that time the sciences of electricity and magnetism have had the most of their growth, and telegraphy has kept pace with the advancing knowledge until its commercial importance is second to no other agency. Very many important principles that are invaluable in telegraphy to-day were wholly unknown in 1840; but it may here be noted that in the telephone, as it now is, there is not a single principle that was not well enough known in 1840. This will be apparent to anyone who follows out the phenómena from the sender to the receiver. First, the sound vibrations in air causing a corresponding movement in a solid body, iron. This iron, acting inductively upon a magnet, originates magneto-electric currents in a wire helix about it; and these travel to another helix, and, reacting upon the magnet in it, produce electro-magnetic effects, and increase and decrease the strength of the magnet; and this variable magnetism affects the plate of iron in front of that magnet, and makes it vibrate in a corresponding manner, and thus restore to the air in one place the vibrations absorbed from the air in another place. To some it may

seem strange that such a simple thing as the telephone is, involving nothing but principles familiar enough to every one interested in physical science, should have waited nearly forty years to be invented. The reason is probably this: Men of science, as a rule, do not feel called upon to apply the principles which they may discover. They are content to be *discovering*, not *inventing*. Now, the schools of the country ought to make their pupils quite familiar with the general principles of physical science, so that the inventive ones—and there are many such—may apply them intelligently.

In making the diaphragm of iron, and having recourse to Faraday's great discovery of magneto-induction, Mr. Bell has been able to dispense with the complication of electrical contacts and batteries, and to cause the vibrations of the diaphragm imparted by the voice to be accurately represented in strength, form, and duration by electrical currents, thus producing the marvellous results of setting up analogous vibrations in the diaphragm of the receiving instrument, which, though weaker than the vibrations imparted to the transmitting daphragm, so closely resemble them as to repeat the quality of voice which causes the original vibrations.

The form of instrument now sold as combining the essentials of portability, convenient form, and maximum results, is shown in section in *Fig.* 2.

A bar magnet A, about 4ins. long by $\frac{3}{8}$in. in diameter, is contained in a hollow wooden frame, which forms a convenient handle to hold the instrument by. Fixed on the top end of the magnet is a narrow boxwood reel, about $\frac{3}{8}$in. thick and $1\frac{1}{4}$ins. over, and wound with about 60 yards of No. 36 silk-covered wire. The sides of the frame have two long holes drilled from C to E, at which end are inserted two binding screws, forming terminals to connect the line-wire to. A short piece of wire, thicker than that the reel is wound with, runs from each of the binding screws E through these holes to the hollow chamber G, where the two ends are connected to the inner and outer ends of the coil B, one to each, the binding screws thus forming the terminations of the coil B. It is immaterial which is joined to the inner and which to the outer end. In front of the upper end of the magnet A a round disc of soft iron is placed, and kept in position by being nipped at the edges by the lid of the case. For a small plate ferrotype iron forms a good material, and, for a larger, thin tin plate. A disc of ferrotype iron, $2\frac{1}{4}$ins. in diameter, is a very suitable size, in conjunction with the 4ins. by $\frac{3}{8}$in. magnet for the instrument shown in this diagram. A

few points needing careful attention to secure successful results in manufacture are as follows:

1. The Cases.—The effects in the receiving instrument being acoustical as well as electrical; dense woods must be avoided in their construction. Cedar, light mahogany, or pine, especially satinwood, are to be preferred. Good results are said to have been obtained by polishing the inside of the case as well as the outside.

2. The Vibrating Discs.—These must be carefully cut out, and free from the slighest bends or dents.

3. The Reels.—Care must be taken in winding to avoid kinks. The reels should be turned down as thin as possible in the inside, so as to have the wire lying close to the magnet. The position of the reel should be quite at the end of the magnet, as there the maximum magnetic variation takes place, and on this the strength of the electrical currents in great measure depends. The ends of the coils are twisted and soldered to the two ends of the wires before mentioned, coming out at C and C^1, each to each. If preferred, the binding screws may be inserted at I, and the ends of the coils attached directly to them.

4. The Magnets.—These should be strong, but the effect not depending on the absolute strength of the magnet, but on the magnetic variation, nothing is gained by using magnets saturated to excess, for the vibration of the plate would cause as great magnetic variation in a moderately strong magnet as in an extra strong one. The pole of the magnet should be advanced as close to the plate as may be without touching; the proper distance can only be learnt by trial. A good plan is to lay a straight-edge across the top of the box before putting the disc and the lid on, and to push the magnet up until you can just see between the two. Once in position, it may be fixed firmly at H by a set screw inserted in the side of the case. An adjusting screw at F, fixed to the end of the case, is also a convenient means of advancing and withdrawing the magnet until the right distance is obtained. It is immaterial which end of the magnet is inserted in the coil.

The foregoing particulars are the essential features of the instrument, as at present made. Nothing is gained by increasing the size of the parts. The relative proportions must be maintained in larger or smaller instruments to get results at all; and the relative proportions being maintained, the instrument is practically the same.

With instruments like these, conversation has been carried on under favourable conditions between places distant 100 miles. As to its adoption for general telegraphic purposes, however, the feebleness of the sound obtained, and the sensibilities of the telephonic current to disturbance from the inductive effects of neighbouring wires, make this extremely problematical. Its greatest success at present is on isolated lines, and for mining, submarine engineering, and other occasions where it has not these distracting and disturbing influences to contend with.

In speaking into the instrument it is necessary to use your natural voice, and to speak clearly and distinctly. It is of great advantage to have two instruments at each end, both being in circuit, and connected up as shown in *Fig.* 3., one of them being held to the ear, and the other to the mouth. The hearing is also greatly assisted by the use of both instruments, one to each ear.

I will now shew you some experiments with this telephone, which, although the same in principle as the one I have described, varies somewhat in form. The other end of this wire is in connection with the telephone which is in Capt. Sale's room across the road, some 200 or 300 yards off. In Capt. Sale's room we have at the present moment a non-commissioned officer who will favour the company with a song through the telephone, and we have also a bugler who will sound the bugle.

[These experiments were successfully accomplished, the tones of the bugle being distinctly heard.]

The telephone is, no doubt, capable of great improvement, which should chiefly be directed towards increasing the relative amount of vibration of the receiving diaphragm.

Improvements will doubtless be directed also towards the accomplishment of simple methods of recording the audible messages received, which has already been attempted by Mr. Edison, and which will be most ably described to you by Mr. W. H. Preece when exhibiting the phonograph, and to whom I will now give place.

Mr. W. H. Preece: The tones which you have just heard from that telephone are, in reality, weaker than those that I heard not very long ago, when lecturing on this subject at Basingstoke. On that occasion the bugler, a Royal Engineer, was at Clapham Junction, 40 miles from Basingstoke, and there the various calls came out more clearly and distinctly than they did just now, the reason probably being that the instruments were in a little better order. On

another occasion, when the apparatus was exhibited to the Queen at Osborne, I was at Southampton. We had a bugler at Cowes, we had an organ in London, and we succeeded in getting calls and music and songs through all those distances; in fact, distance seems to offer very little obstacle to the working of the telephone. The difficulty is more the induction which exists between wire and wire, and when a wire working a telephone is carried on the same poles as other wires carrying messages, every single wire seems to have some influence on the telephone wire, and the result is that you hear on the telephone a rushing sound, something like hail pattering on the window; some say it is like fat frying in a pan, others say it is like peas shaken in a dry bladder; the sounds are very curious, and they entirely prevent conversation to any great distance.

I could go on for an hour or two to tell you about the telephone, but, however, I have something even more interesting. To us the telephone is a thing of the past. It is only six months since I had the pleasure of bringing the first instrument over to this country. I happened to be in America on a visit last summer, and I brought the first telephone to England, and exhibited it at Plymouth. That was six months ago, yet to me the telephone is a thing of the past. I have now a new baby, which I am now going to shew you.

The principle underlying the telephone, however, is the same as that underlying the phonograph. How is it that when I speak to you, when the bugler sounds in Capt. Sale's room and you hear it here, that all these sounds are passed through this little channel we have to the tympanum of the ear, and then to the brain to produce the sensation called sound? It simply is, that any sudden motion of the air, such as clapping my hands, parting my lips, sounding a trombone, beating a drum, throws this air into vibration, and although we cannot see at the present moment the effects of sound on the atmosphere, the whole of the air within the room is chased and turned, and engraved in the most exquisite way. If it were possible to shew you the sonorous waves in this atmosphere you would be astonished with their beauty. It is impossible to shew them actually, but it is possible in various ways to give you evidence of their existence.

If I take any elastic diaphragm, such as I have here, and speak at it, I cause that diaphragm to vibrate. If I held a drum before my mouth the drum would vibrate; and when I speak at this thing you can hear by that curious grating sound that I cause something to vibrate. You can hear the difference between my voice outside

and my voice inside. But the only difference between the two is, that this little indiarubber diaphragm when I speak at it vibrates, and in vibrating it brings into contact two hard points.

Now, it is quite possible to shew the effect visibly before you, and to shew that for every vibration of the voice, contact is made, and something is done. But let me first point out to you this, when a note is sounded it varies in three different ways. We have, in the first instance, the pitch of the note; that is, the distance between C D E F, and so on. The pitch of the note is simply dependent on the number of vibrations in a second that enter our ear. So that if I sound C—I do not know that this is C, but let us assume that it is—that makes 264 vibrations per second. If I sound an octave higher than that I just double the number of vibrations. If I sound D, then the vibrations are 280; so that the first quality of a note is its pitch, and that is the length of the wave, or the number of vibrations per second. The second quality of the note is its loudness. I can speak to you softly or I can speak to you loudly. A trumpet can be blown gently or loudly, and so with everything else, and these various gradations of sound are produced by the different amplitude of these air waves. When I speak low the amplitude of the air waves backward and forward is very small. When I speak loud it takes a larger excursion to and fro and hits your ear with greater force. The third quality of sound is a quality that determines the difference between a sweet lady's voice and a coarse man's voice, between a piano and an organ. The difference between all these different notes is what is called the quality of the sound, and that simply arises from the difference of the form of the wave.

Now, I want you to bear those three points particularly in view, because it is on those three points that the whole secret of the working of the telephone and of the phonograph depends. I cannot talk long enough to induce darkness to come upon us, and I rather want darkness for the experiment I have first to show you, which, I am afraid, will not be so successful as it would be later; but with the assistance of my friend Mr. Edmunds, who has brought here an extremely pretty experiment designed to show you visibly the existence of these number of vibrations as I told you distinguishing one note from another, I hope you will be able to see something of it. He takes hold of that little instrument that I had in my mouth, which is in connection with a battery: the current from that battery passes through what is called an induction coil,

and in going through that induction coil it sets up currents of electricity. Those currents of electricity pass through a glass tube which is exhausted of its air and replaced by some gas. It is so connected with a magnetic mill that when I put this battery down and start that little mill going you will see we have rotation. Every note that Mr. Edmunds sounds will give a certain number of vibrations. If he sounds the note C he will give you 264 vibrations, and 264 currents will pass through that vacuum tube. For every note he makes there will be a different number of vibrations, and if it is dark enough you will see that every note will give a distinct figure.

[The experiment was performed accordingly.]

If it had been darker you would have seen it better, but the effect has been sufficient to shew you that when we direct our voice at a diaphragm that diaphragm vibrates. We have a proof of it there in the fact that for every given number of vibrations we have a different figure in the vacuum tube.

Now the history of the discovery of the phonograph is rather curious.

Mr. Edison, one of the most distinguished electricians in America, a character and a genius in his way, a man whose whole time is devoted to invention, and who is paid for invention, has been occupied very largely in endeavouring to improve the telephone. On making some experiments with the telephone he, one Wednesday afternoon, accidentally pricked his finger with the diaphragm of the telephone, and that set him thinking. He thought if the vibrations of the plate of a telephone would prick his finger, why should they not prick something else and thereby reproduce sound. Well, he thought upon this until he saw his way to it. He started on Wednesday afternoon, he worked all Wednesday night, he worked all Thursday, he worked all Thursday night, he worked all Friday, he worked all Friday night, and on Saturday morning he succeeded in producing an instrument, which is now called the Phonograph, that repeated sounds distinctly and clearly. He then retired to bed and slept uninterruptedly from Saturday afternoon till Monday morning.

Now Mr. Edison did not know what had been done in this direction in England. It happened, curiously enough, that other minds had been working in this field, not quite with the idea of reproducing sound, but with the idea of recording sound. There are a class of gentlemen in this world, to whom we are very much indebted, called shorthand writers, and if it were not for those able

shorthand writers we should not be able to read at our breakfast table in the morning those wonderful ideas that are promulgated in the House of Commons the night before. Mr. Barlow, the celebrated engineer conceived the notion that it was possible to dispense with the services of these gentlemen, and he thought he could invent an instrument which would record in marks the words and the sounds which emanate from the lips. He produced an instrument called the Logograph; and I have in my pocket a strip from this logograph, which has been enlarged on this diagram. Now the logograph is simply that same instrument which Mr. Edmunds has used, only instead of making two points which vibrate make contact, and complete the galvanic circuit, Mr. Barlow made one point fixed to this diaphragm vibrate, and record itself on a strip of paper, and the kind of lines that were recorded is shewn in *Fig.* 4, which represents the vibrations produced by the couplet:—

> "Know then thyself: Presume not God to scan;
> The proper study of mankind is man."

I told you the distinguishing features of notes and sounds are three; first, the number of vibrations per second; secondly, the amplitude of those vibrations, and, thirdly, the form. We have all these three qualities shewn on this diagram. We have first those rapid little vibrations indicating the pitch, which are too minute to be seen. In the prominences and valleys, the hedges and ditches, you have the amplitude of those sounds, producing their loudness, and in the particular form that these curves take you have that quality which distinguishes one word from another, or one voice from another, and here, if we had that repeated, you would find the same curves would be constantly repeated.

Now, Mr. Edison, instead of recording these marks on paper thought he would record them on tinfoil, and according he constructed a cylinder with an axle at each end, as you see in this first instrument, *(see Fig.* 5*)*. Here is a brass cylinder about six inches long, and four inches in diameter, with a long axle extending at each end. One end of this axle has a thread upon it so that when it is rotated it has a lateral motion backward and forward. When turned in one direction the cylinder will move in one way, and when turned the other it will move back again. On this cylinder there is a spiral groove cut which is exactly the same pitch as the screw on the axis. This cylinder is covered with tinfoil, as you see it here. On the side of the cylinder is fixed just the same diaphragm as that of the telephone, but with a point fixed to it. As

the diaphragm vibrates it moves up and down, and as the cylinder rotates so it will receive the impressions of the point that is moving up and down *(see Fig. 6)*, and if we were to take a section of the tinfoil in the circumference of the circle it describes, we should find that the tinfoil would be indented in the same way as the curves are made on Barlow's logograph *(see Fig. 7)*. So that when you speak at a diaphragm of that kind all you do is to cause that diaphragm to vibrate. The diaphragm in vibrating causes the point to vibrate; the vibration of the point indents or marks the tinfoil that is rotating in front of it, and as there is this screw motion here the cylinder gradually works its way along, and the result is that after you have made a short speech to the phonograph, on the whole surface of this tinfoil you have in little dots and marks the sounds recorded. You have on this piece of tinfoil words, laughter, song, music, all kinds of curious things recorded, and if we took this tinfoil and coiled it upon another phonograph we should be able to reproduce the sounds that were first given to it. How? Simply in this way. When you reverse this action and instead of speaking at the diaphragm you leave the diaphragm to itself, then the little point instead of its making the marks on the tinfoil is caused to move up and down, and in moving up and down the point would cause the diaphragm to vibrate, and if I move the cylinder with precisely the same velocity that it rotated when it received its marks, then I should make it vibrate exactly in the same way as I made it vibrate with my voice, and the curious effect is this. The effect that we saw in the telephone, as in the phonograph, is, that when you cause the diaphragm to vibrate, if it vibrate in pitch, in amplitude, and in form with the sounds that you gave to it in the first instance, it will exactly reproduce those sounds, and in this phonograph if we have first of all marked or recorded upon the tinfoil the waves of sound, then when we simply cause the thing to go over its course again we reproduce those sounds; that is the simple principle of the phonograph. First of all you have a diaphragm against which you must speak, that diaphragm must vibrate, the vibration of that diaphragm must make marks upon a tinfoil, and when you reverse the process the marks on the tinfoil cause the point to move, the point causes the disc to vibrate, the disc throws the air into the same sonorous vibrations that it had at first and reproduces sound. In order to give you absolute proof of this, I will ask Colonel Bolton to come and say something to the phonograph itself. I may first mention

this, that in the early instances the rotation was made by hand, but the motion imparted by hand was an irregular motion, and the sounds produced were not always an exact repetition of those given into it, for instance, I shall never forget the first words I said myself to the phonograph before a very large audience. I thought I would look over all the learned literature of the period, and I examined all our great poets going back to our earliest authors, and at last I seized upon the very well known and ancient quotation "Hey diddle diddle, the cat and the fiddle." I said that to the phonograph but it came out in a very curious manner, simply from the fact that the last rotation was quicker than the first; to cure that, Mr. Stroh, to whom we are indebted for this second instrument to day *(see Fig. 8)*, has improved it, the instrument made by Mr. Edison, the inventor, does not work so well as this which has been made by Mr. Stroh, I was particularly anxious to introduce this instrument before the Royal Institution, and Mr. Stroh, one of the best mechanicians of the day, by dint of hard work succeeded, by labouring almost as hard as Mr. Edison did, in not only producing an instrument, but he added to it clockwork, and has given to it that uniform motion which is necessary. He has kindly come down himself to day and will work this instrument for us.

[Colonel Frank Bolton then spoke two or three sentences into the phonograph, concluding with several peals of laughter, and hip, hip, hurrah, which were reproduced in the most marvellous manner, but as it were upon a miniature scale.]

One curious fact is this, that these tinfoils can be used over and over again, and we will just repeat that performance to show you that, if anything, it will be improved by having gone once through the process.

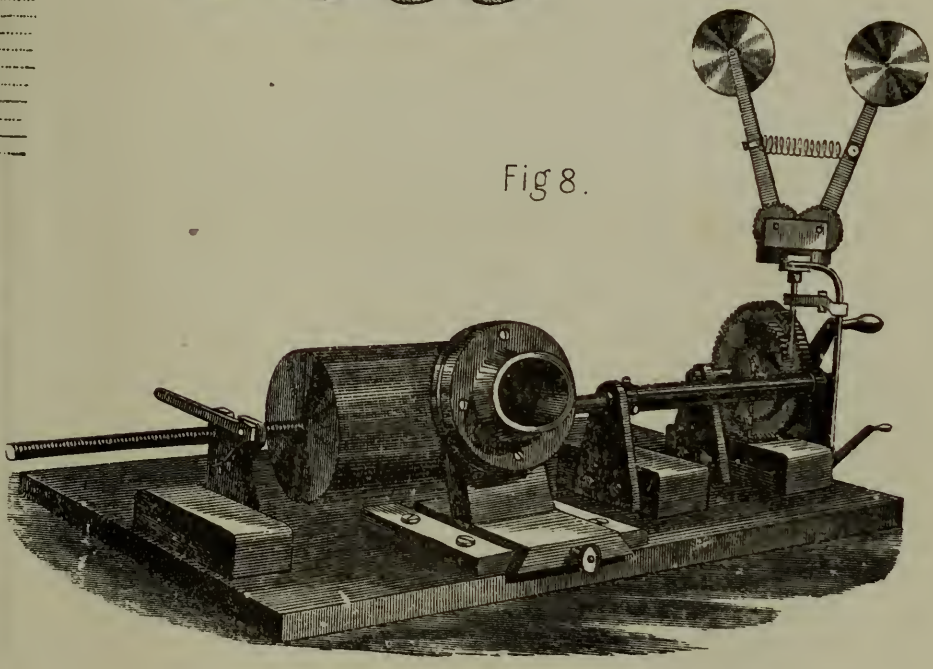
[The experiment was again repeated with the same tinfoil. Major-General Newdigate also uttered some words of command into the instrument, which were also reproduced.]

The piece of tinfoil having now been entirely filled up with these words, we have now to place a new piece of tinfoil upon the cylinder, and this is an operation of extreme simplicity, although it takes a little time. As soon as we have a new tinfoil on we will try the effect of music; we have a Bugler here and some singers, and will fill up the next tinfoil with the music. It is a most remarkable thing that you can superpose one voice upon another, and by the aid of a double mouthpiece it is possible for two voices to make their marks at the same time.

[Two Serjeants then sang a verse of the duet "Larboard watch," which was reproduced. The next experiment was the sound of a drum, and then the bugle, each of which come out distinctly, but when the double mouthpiece was put on, and the drum and bugle played together the remarkable effect was produced, that the bugle entirely effaced the sound of the drum, the former alone being heard. Several other experiments were successfully performed.]

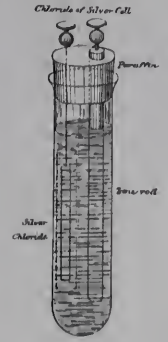
Fig. 7.

Fig 8.



DE LA RUE'S BATTERY.

Fig. 1.



SECTIONS OF BELLS TELEPHONE

Fig 2.

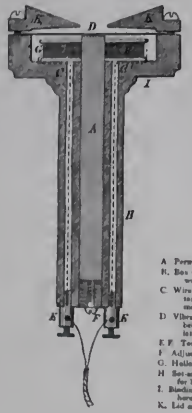
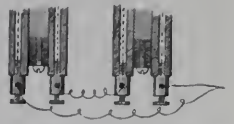


Fig 3.



Showing how the circuit is completed when two instruments are used, one being held to the ear and the other to the mouth.

NOTE. Fig 2.

A Permanent bar magnet.
B. Box wood reel, fixed on end of magnet, on which is wound the fine silk-covered wire.
C Wire connecting the fine wire on the reel with the terminals E F, where the line wire is connected by means of the binding screws.
D Vibrating disc of forrotype iron, kept in position by being nipped at the edges by the lid of the case. The latter is shown, not quite screwed down, at K K
E F. Terminals.
F Adjusting screw.
G. Hollow chamber.
H Set-screw may be placed here for holding magnet.
I. Binding-screws may be inserted here if preferred.
K. Lid of case.

PHONOGRAPH.

Fig 4

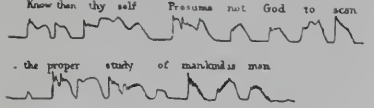


Fig 6.

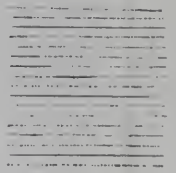


Fig 7.

Fig. 5.

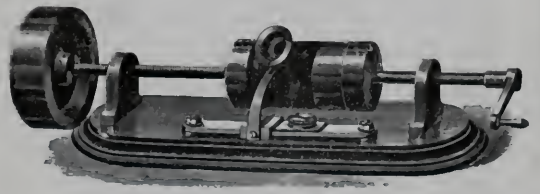
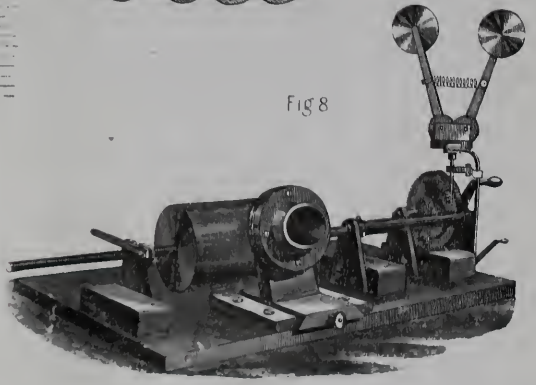


Fig 8



PAPER XVI.

THE

THIRD BATTLE OF PLEVNA.

26-31*st August (7-12th September)*, 1877.

(*Continued from page* 103.)

TRANSLATED BY LIEUTENANT A. O. GREEN, R.E.

FROM THE *Revue Militaire de l'Etranger.*

REPORT OF LIEUT.-GENERAL SKOBELEFF TO THE COMMANDER OF THE ARMY OF THE WEST, DATED 3RD (15TH) SEPTEMBER, 1877.

"Placed, after the capture of Lovcha, in the detachment of Prince Imeretinsky, of which I commanded the first echelon, I took part in the affairs before Plevna up to the 30th of the preceding month. The troops under my command comprised the regiments of Esthonia and Kalouga, the 9th and 10th battalions of chasseurs the 1st, 2nd, and 3rd batteries, the long range battery, and three sotnias of Colonel Tchernozouboff's brigade; total, eight battalions, 36 guns, and three sotnias.

"I have addressed a report,* dated the 3rd September, a copy of which will be found annexed, to Major-General Prince Imeretinsky, upon the part played by my detachment up to the 30th August.

"On the evening of the 29th, I received the disposition intended for the Army of the West for the 30th August, the day designed for the general attack upon the intrenched camp of Plevna.

"By this disposition I had under my orders a detachment composed as follows: 1st brigade of the 16th division, Major-General Tebiakina; 3rd brigade of chasseurs, Major-General Dobrovolsky; the Revel regiment; three 9-pr. batteries, and one 4-pr. The mission of this detachment was to attack the intrenchments which defend Plevna on the side of the Lovcha road.

* This is the report already given in Vol. ii., Page 96.

"The remainder of the troops* of the 2nd division and their batteries followed my columns in reserve, under the orders of General Prince Imeretinsky, with the view of supporting their attack and protecting their left flank.

"The attack was to commence at 3 p m. To ensure, therefore, the execution of the task confided to me, it remained :—

"1st. To carry the third and last ridge of the *Montagnes-Vertes.*

"2nd. To seize the redoubts and lines of shelter trenches, which defended the approach to the intrenched camp on the side of the *Montagnes-Vertes.*

"Already on the morning of the 29th August, a reconnaissance, which I had made of our position to the east of the Tuchenitsa ravine, allowed me to make choice of a favourable position in this region for the artillery, from whence the latter could cannonade the northern slopes of the *Montagnes-Vertes*, and thus forbid all approach to these heights to the Turkish troops coming from the camp of Plevna. At 7 a.m., the 3rd battery of the 2nd artillery brigade, a detachment (half battery) of artillery of the 2nd battery of the same brigade, and the long range battery, escorted by two companies of the Souzdal regiment received orders to cross the Tuchenitsa ravine, to take up the selected positions. The fire of this artillery, opening on the 29th, facilitated the assault of the third ridge of the *Montagnes-Vertes.* The Vladimir regiment was detailed to carry these heights.

"At 10 a.m., the Vladimir regiment, formed in two lines of company columns, having the 10th battalion of chasseurs on its right flank, three companies of Esthonians on its left, and three batteries in reserve, commenced its offensive movement. The orders of the officer commanding this regiment were, when once he had attained the summit of the ridge, to stop there, and to intrench himself whilst awaiting the hour of the general attack.

"The first line, received by a very hot fire directed upon it by adversaries who were well under cover behind their intrenchments, scarcely replied to the enemy, and arrived in good order on the appointed ridge, where it endeavoured to cover itself as much as possible, taking advantage, with this object, of a very soft soil and high crops of maize ; it took up its position, and only then opened fire. The enemy, seeing our forward march arrested, took the

* 1st brigade of the 16th division (4th army corps) ; 1st regiment (Vladimir), and 62nd regiment (Souzdal). 3rd brigade of chasseurs : 9th, 10th, 11th, and 12th battalions.
2nd division : 1st brigade, 5th regiment (Kalouga), and 5th regiment, (Liebau) ; 2nd brigade 7th regiment (Revel), and 8th regiment (Esthonia).

offensive, threw forward large masses, especially on our flanks, and commenced to press our first line vigorously. A very sharp musketry fire ensued, which lasted from 11 o'clock in the morning until two in the afternoon. It was impossible to maintain this struggle until the hour appointed for the decisive attack, unless by covering this first line by shelter trenches, and choosing a well sheltered position for the reserves. During this time all the supports of the first line (3rd Vladimir battalion) came by degrees into action. The considerable losses suffered by the Vladimir regiment and the 10th battalion of chasseurs, and the continually increasing masses which the enemy brought into line, forced me to take the Souzdal regiment from the reserve, and place it by battalions in rear of the Vladimir regiment. Towards two in the afternoon the dense chain of Turkish sharpshooters approached our lines so closely that we suffered severely, not only in our first line (Souzdal regiment), but also in our first reserves, posted a *verst* (1167 yards) distant from the fighting line. It became impossible to remain any longer in position; therefore, as the hour for the general attack was approaching, I ordered the Souzdal regiment to attack and dislodge the enemy from the *Montagnes-Vertes*. The men of Souzdal rose up with enthusiasm, and under a hailstorm of shot and shell, attacked the enemy most vigorously, without uttering a single hurrah! The enemy gave way, evacuated the *Montagnes-Vertes*, and retired in disorder upon their redoubts, whence, sheltered behind their parapets, they commenced at once to riddle us with balls.

"In the meanwhile, the hour for the general attack drawing near, it was incumbent to take all the necessary preparatory measures immediately.

"In addition to the Souzdal and Vladimir regiments, the 9th and 10th battalions of chasseurs already engaged, I led the Revel regiment into the fighting line, and placed it in rear of the third ridge, in the valley, and then the Liebau regiment and the 11th and 12th battalions of chasseurs behind the second ridge.

"Two battalions of Kalouga and two of Esthonia remained in position on the second fortified ridge; a battalion of Kalouga occupied the village of Brestovets. A third battery (the 5th of the 3rd brigade) was brought up into the artillery line (the second fortified ridge), and on the stroke of half-past two, the three batteries opened their hottest fire upon the redoubt to be assaulted.

"I will take the liberty of remarking here that the cessation of fire, laid down in the general disposition for half-past two, was a difficult

order for my troops already seriously engaged. At three o'clock I gave the order to attack the redoubts. The Vladimir and Souzdal regiments, supported on the right by the 9th and 10th battalions of chasseurs, rose and rushed forward with bands playing and drums beating. It was necessary to descend the wooded slopes covered with vines, from the third ridge, to enter the valley, in which flowed a stream with steep banks, to cross this stream and to climb a stiff slope completely bare for about 300 *sagenes* (700 yards), on the summit of which the redoubts were placed. The Turkish intrenchments consisted of two redoubts of good profile, provided with traverses, and connected together by deep trenches, and with shelter-trenches or rifle-pits for skirmishers, dug in front of the redoubts, on the slopes of the plateau. The attacking troops were received by a terrible musketry and artillery fire from the rifle-pits and the two redoubts attacked, as well as from the Krishina redoubt. In addition, the 4th corps having failed in its attack on the redoubts against which it was directed, we received from that side an enfilade fire, which helping that from the Krishina redoubt, occasioned us considerable losses. The first fighting line, on arriving at the stream, halted, and only a strong chain of skirmishers was able to proceed further, to approach the bare slopes, to lie down on the ground and open a musketry fire, inoffensive enough against a perfectly covered and concealed enemy, whilst the fire of the enemy occasioned them severe losses.

"I ordered the Revel regiment to support the attack, and my last reserve, the Liebau regiment and the chasseurs of the 11th and 12th battalions, to advance and replace the Revel regiment.

"The Revel regiment advanced to the attack as if on parade, approached the brook, crossed it, and commenced to ascend the slopes, carrying with it a part of the Vladimir and Souzdal regiments. But these forces were insufficient, against an enemy superior in numbers, to overcome and break down his fanatical resistance, and above all to resist such an awful fire *(feu d'enfer)*. The soldiers of Revel arrived half way up the hill, stopped, and the fragments of the Vladimir and Souzdal regiments, of the 9th and 10th battalions of chasseurs, who remained at the stream, commenced to dissolve and fall away, and to return to the rear. The moment was critical. It was necessary to make choice of two alternatives: either, first, without losing a moment, to throw the final reserves forward, and break down the resistance of the enemy with all the forces brought into the first line; or, secondly, as the neighbouring

4th corps was beaten back, to bring a portion of the reserve into action, and under its protection to withdraw the Vladimir, Souzdal and Revel regiments, and the two battalions of chasseurs, the 9th and 10th. I pass over the third alternative : to relieve the troops, and renew the attack with the Liebau regiment and the two battalions of chasseurs in reserve, for I was already convinced that five battalions would be unable to accomplish what eleven battalions had failed to perform.

"After reinforcing the attacking troops with twelve fresh companies from the Liebau regiment and the 11th and 12th battalions, I pushed forward these details, and carried with them the soldiers of Vladimir, Souzdal, Revel, and the remains of the chasseurs on No. 1 redoubt. Arrived within range of the first entrenchments of the enemy, we rushed forward with loud hurrahs! The Turks made no resistance, and fled towards the redoubt.

"This first success re-invigorated the attacking troops; hurrahs resounded more and more; we approached nearer and nearer to the enemy, not with closed ranks, but in small bodies—the bravest and most active in front; the aim of the adversary, the nearer we approached, became less certain; symptoms of hesitation commenced to appear in the ranks; one effort more, and the bravest of our men threw themselves into the trenches, and a few minutes later (at 4.25 p.m.) into redoubt No. 1. The Turks fled, the bravest of them being slaughtered on the spot. A large and strong redoubt, the trenches which connected it with No. 2 redoubt, and a gun; such were the trophies of this furious assault. However, we were not long in perceiving that our success was not secure from certain eventualities; very far from it.

"The troops which had recoiled from the attack commenced to arrive in the captured redoubt, and soon some thousands of men of different regiments occupied either the interior of the redoubt, or found shelter in the ditches and trenches. The last arrivals, finding no cover, were exposed to the fire of redoubt No. 2. But our greatest danger came from another direction. Redoubt No. 1 was not closed at the gorge on the side of the Krishina redoubt, and the Turks, from the moment they were certain that No. 1 redoubt had been taken, directed upon it the fire of the Krishina redoubt. Each projectile falling into the interior of the redoubt in the midst of the masses which occupied it, struck down a dozen men and demoralised the survivors.

"A terrible rifle fire was soon added to this artillery fire from the

Krishina redoubt. The Turks, issuing from their camp in rear of Krishina, advanced on our left flank, whilst other large masses attacked us in front. In front of the line of the enemy's skirmishers several figures were to be observed of a decidedly Turkish cast of countenance. Amongst others a fair man in a white head-dress. The situation was becoming critical, and it was necessary to devise means for protecting our left flank without a moment's delay. Staff-Captain Kouropatkina, who, up till now, had not ceased during the assault, as elsewhere, to give an example of the most brilliant courage, succeeded in withdrawing 200 or 300 men from the redoubt and intrenchments, and in conducting them some 200 paces from thence in the direction of Krishina, with the object of forming a dense line of skirmishers, which immediately opened a hot fire upon the troops which were attacking our left. The reinforcements, which arrived in succession, of different groups of men of all sorts, placed themselves on the left of this line, and towards a quarter past five we succeeded in driving back the enemy, although the losses on our left, which was much exposed, were very heavy. The musketry fire directed upon our left wing died away a little towards half-past five, and on this side our men might have sheltered themselves rapidly, and rendered the positions, which had cost them so dear to carry, difficult of approach; but the almost entire absence of field intrenching tools did not allow of this being done.

"The retreat of the Turks, who had attacked us on the Krishina side, was brought about, partly by the appearance of our cavalry near the redoubt, partly by the fire of a horse artillery battery, and finally by the bold irruption of our Cossacks into the village of Krishina itself. In the meanwhile the fire of redoubt No. 2 continued to cause us serious loss. Moreover, a body of about 50 Turks still remained in the trenches, situated at about 100 paces distant from the captured redoubt. Some officers succeeded in getting together a 100 or so of willing men, who rushed forward under a murderous fire, charged the Turks with the bayonet, and either put them to flight or bayonetted them in their intrenchments. Carried away by success, these brave men continued their victorious charge in the direction of No. 2 redoubt, without stopping to inquire whether they were supported or no; help could not arrive in time, and this handful of brave men were obliged to turn back, reduced to 20 or 30.

"At this moment the greatest activity was displayed in rear of the detachment. Major-General Prince Imeretinsky was taking all

possible measures to support our attack, and to assist us to maintain the captured positions. At the same time he ordered up the sickbearers and ambulances on to the battle field to carry off the wounded. Staff-Colonel Schetsakoff stopped all men straggling about, reformed them up into detachments, and sent them again under fire.

"At 5 p.m. strong columns descended the slopes of the *Montagnes-Vertes*, and commenced crossing the brook. They consisted of three fresh companies of the Liebau regiment, two companies made up of the men of Souzdal, some companies formed out of the men of the 12th battalion of chasseurs, and a few hundreds of men from the Revel regiment.

"The chasseurs and soldiers of Revel were directed to the left with the object of covering us on the side of Krishina; the men of Liebau and Souzdal were moved up to the attack of redoubt No. 2. On the left, the defenders of redoubt No. 1 made a sortie, and about half-past five our men entered redoubt No. 2 from both sides at once, and carried it.

"Lieut.-Colonel Mostsevoy, of the Souzdal regiment, took command of all the troops assembled in redoubt No. 2, which he defended most heroically, as will be seen further on, against all the attempts of the Turks. In redoubt No. 1, Major-General Dobrovolsky had, in the first instance, assumed command, and when he was mortally wounded, Major-General Tebiakina took his place.

"Another, but weaker column, composed of two-and-a-half companies of the Vladimir regiment, arrived behind the Liebau and Souzdal columns. Major Gortaloff, of the same regiment, after forming them, had led them himself, on his own initiative, upon redoubt No. 1, and Major Gortaloff gave the most useful assistance to Major-General Tebiakina, and was the life and soul of the resistance offered to the attacks subsequently made by the Turks.

"Night, in the meanwhile supervening, did not put a stop to the struggle, but only lessened its intensity. Musketry fire continued in all directions, more or less hot in different places; and, as we had entered the enemy's positions in the form of a wedge, the whole of our position, from the line of the captured redoubts as far as the first ridge of the *Montagnes-Vertes*, was swept by a concentric fire from three different sides.

"The position of the force during the night of the 30-31st, was as follows:—

"The detachments of the Vladimir, Souzdal, and Revel regi-

ments, three companies, and a combined detachment of Liebau, and detachments of the 9th, 10th, 11th, and 12th battalions, occupied the two redoubts and the trenches connecting them.

"In rear of our fighting line, Major-General Prince Imeretinsky had two battalions of the Esthonia regiment, who were covering our left flank on the Krishina side, a battery of 24 guns on the second ridge, and the Kalouga regiment, very much weakened in strength, and one battalion of which was occupying the village of Brestovets. In addition, small detachments were formed during the whole night in our rear, by means of stragglers and men slightly wounded. Between the line of the redoubts and the position occupied by the artillery and the regiments of Esthonia and Kalouga, upon the second ridge, there was a wide tract of about 800 *sagenes* (1867 yards), entirely destitute of defenders, and covered with killed and wounded not yet carried to the rear.

"I felt all the danger of an attack directed upon this part, and coming either from the side of Krishina or from the enemy's camp, —an attack which might isolate and completely cut in two the troops occupying the redoubt; taking advantage, therefore, of the obscurity, I took all measures necessary to mask the weakness of our position on this side, as I wished to maintain it at all hazards until morning.

"I placed myself, in person, at the foot of the wooded heights, half-way between the line of redoubts and our artillery position. Prince Imeretinsky sent to me to this point a weak battalion of Esthonians, which had to defend at the beginning, unaided, a tract 400 *sagenes* long, by 800 *sagenes* deep (about 933 yards, by 1867 yards).

"More or less safe in front and rear, I covered the right and left flanks by two companies of the Esthonia regiment, pushed as far forward as possible, and extended in skirmishing order. Three companies were in reserve. To these I added, with the aid of my staff, the stragglers from different corps, who came in one by one from the redoubts and trenches where they had been unable to find places, and lastly, the laggards, who had lost all trace of their regiments and officers. After two hours work we succeeded in assembling in this manner as many as 600 men with a few officers.

"All comers were arranged without regard to regiments, and formed into squads and companies. A little later on the strength of this improvised battalion reached 1000 men, and it became pos-

sible to separate the men of various regiments and to form a company with those of the brigade of chasseurs.

"The companies of the Esthonian regiment had scarcely commenced to deploy into skirmishing order in the direction which had been indicated to them, when the musketry fire, hitherto weak enough, recommenced in a more lively fashion on our left flank. The Turks had evidently discovered our weak point, and were trying to force our left flank in order to turn the defenders of the redoubt. Received by the fire of the Esthonian companies, and not being able in the darkness (the night was pitch dark, and from time to time a steady rain fell) to make out the feeble strength which was opposed to them, they stopped and contented themselves with a fire which lessened by degrees, and soon ceased altogether. At the moment when the fire was at its hottest on this side, I took two sections of the Esthonian regiment to strengthen the line which covered our right flank.

"No sooner was the fire silenced on our right flank than it recommenced on our left, and from this side we heard regular vollies. Bullets began to strike the ground occupied by the reserves of the Esthonian regiment, and caused casualties. Some Cossack volunteers from the escort, sent to reconnoitre in this direction, returned to say that it was our own men who were firing. Thinking that some portions of the 4th corps were taking advantage of the night to carry the positions which had resisted them during the day-time, I forbade the Esthonians to reply to this fire, and despatched a strong patrol in the direction of this invisible enemy, who was troubling us with his volleys. This patrol was able to make sure that there were no Russian troops in this direction; but that the Turks, who had most probably come out of their camp with the intention of piercing our right flank, had made an advance, and not daring in the darkness to penetrate as far as our rear, had halted at some hundreds of paces from the Esthonian companies to volley them. I ordered the Esthonian companies to reply to the enemy's fire so as to show our presence; the volleys soon ceased, and degenerated into a fire of skirmishers.

"I was afraid of a fresh attack on our rear; leaving two-and-a-half companies of Esthonians in position in the line, I proceeded with the remaining companies and the improvised detachment 300 *sagenes* (700 yards) to the rear, towards the third ridge, with the greatest silence; I covered my right wing with two and a half companies of Esthonians, one of which was placed in the line, and

touched the left flank of a company already deployed in this direction; the remainder, a company and a half, served as a support. I reinforced the line which covered our left flank with the improvised battalion. The other companies were drawn up in two lines, facing the redoubts, and the improvised company of chasseurs was withdrawn a little to the rear as a reserve.

"The rear line was scarcely placed in position when the firing, which had slackened a little, recommenced with fresh vigour. This fire, delivered in the darkness, did not do much credit to the enemy, and only occasioned us trifling loss, but it showed the proximity of the enemy, and obliged us to hold ourselves in readiness at any moment for a decisive action. By this time the fatigue was so great that the men fell asleep as soon as they were halted. Thus, to keep them in exercise, I was obliged from time to time to make them stand up, bring them into line, have them mustered and send strong patrols along the line. At 11 p.m., two sotnias of the Vladikavkaz regiment, and two sections of the 34th regiment of the Don joined me in the position. These last reinforcements allowed me to send a few small cavalry outposts in front of the line, and to connect myself with Prince Imeretinsky's troops.

"Besides, having 50 or 60 men of the Cossack regiment of Vladikavkaz in hand, I felt myself very much more at ease, as I was determined, if the enemy attacked us during the night, to hurl this handful of brave men upon them, and sacrifice them in case of need.

"Our situation, which was already so difficult on account of its being exposed on three sides at once to the enemy's fire (a fire which produced more moral than material effect), became still more painful owing to the cries of the wounded, who were everywhere crawling about around the reserves. The ambulance parties were occupied in collecting the wounded on the third ridge, and the darkness, as well as an incessant fire, had hindered them from arriving at our position.

"In addition to the carrying off of the wounded, we had still to deal with a very important question, viz.:—the replenishment of the cartridge cases of the defenders of the redoubt. The fight, which had lasted from eight in the morning until eight at night, had exhausted the ammunition of a great portion of the troops, the want of cartridges was particularly felt by the chasseurs of the 3rd brigade, and of course with the difference of the armament, it was all the more difficult to provide for them at an opportune moment. The non-commissioned officers of Cossacks who were sent to the

ammunition wagons (in default of officers of the Ordnance Department who were placed *hors-de-combat*, or had left the ranks from other motives), could only distinguish with difficulty between the ammunition wagons of the line and those of the chasseurs; in the heat of the fight, with the inevitable disorder in the columns of wagons, and above all in the night, a similar problem is insoluble even for an officer. And this is only one of the least disadvantages of having two patterns of arms for the infantry. Two ammunition wagons for the infantry were brought up into the position I was occupying, and special detachments were employed in carrying cartridges to the redoubts. The Cossacks helped, carrying the cartridges in their nose-bags; twenty Cossacks were sent to the rear to the Berdan ammunition wagons, and succeeded by daybreak in furnishing the chasseurs with a sufficient quantity of ammunition to continue the fight. However, the night was quite as bad in the redoubt as in the position which I had occupied in rear.

"The Turks, as has been seen above, tried several times before nightfall to drive us out of the redoubts, but without success.

"The men not being under cover, all these attacks cost us very dear.

"On the approach, too, of night, the construction of lodgments on the side of the Krishina redoubt, and the conversion of the captured trenches for the use of our troops, was at once put in hand. Staff-Captain Kouropatkina was able, whilst there was still daylight, to trace these lines. They were traced one hundred paces in rear, on the open side of the redoubt; and a part of these trenches in front of the Krishina redoubt were worked into the general front by two new lodgments, the least advanced of which prolonged the line of the enemy's trenches, connecting the two redoubts (captured). The almost entire absence of field intrenching tools rendered this task very difficult for the troops. The soldiers who understood the importance of cover, dug up the earth with the covers of their mess tins, with the bayonet, or with their sabres, and removed it by hand. The shelter huts of the Turks were demolished, and the branches used to strengthen the earthen parapets. We found the traverses constructed by the enemy of sods particularly useful, as they were so easy to demolish by hand.

"In order to turn the enemy's intrenchments to account, the soldiers were ordered to strip the sods from the parapets, and to shelter themselves with them from the adversary. Finally, in the ditches of the redoubts, which were twelve feet deep, the soldiers

dug themselves pits in the counterscarp, which took them breast high. The largest works were carried out in No. 1 redoubt. At nightfall the fire directed upon the defenders of the redoubts slackened a little; but afterwards, towards 10 p.m., the Turks, having collected in considerable force, rushed upon our brave soldiers, weakened by the prolonged struggle. Our people, warned besides by the cries of the Turks and by their very inefficient fire, received the assailants with a fire directed on the side from which the shouts and rifle shots proceeded.

"The Turks renewed their attacks several times, but without success.

"After the repulse of one of these attacks, our people, who had ceased firing, heard a well-sustained fire which seemed to come from behind an inequality of the ground. This turned out to be, as was known later on, fresh reserves of the enemy, who mistaking their own retreating men for Russians, had fired upon them.

"From dawn until 6 a.m., the Turks did not disturb us, and were satisfied with keeping up a feeble fire. We took advantage of this respite to withdraw several hundreds of men of different corps from the redoubt, where they were uselessly crowded together in the open, and could be of no possible assistance in the defence of the interior.

"I now added the last battalion of Esthonia, which had been sent to me from the rear under its brave commander, Lieut.-Colonel Ern, and a few companies formed out of parts of the Revel, Liebau, and Vladimir regiments, to the two and a half companies of Esthonians and the combined battalion. At 6 a.m., the enemy commenced cannonading us vigorously from the Krishina redoubt, and the redoubts to the east of the town of Plevna.

"From the commencement of the fire we had to submit to considerable losses. In order, if it were possible, to silence the guns in the Krishina redoubt, I ordered the commander of the second battery, 2nd brigade of artillery, Lieut.-Colonel Baumann, to bring up one of his detachments (half batteries) to redoubt No. 1. The captain of the battery, Vasilieff, who was already wounded, but remained at his post, offered to lead the detachment.

"This half battery, overwhelmed on all sides by infantry and artillery fire, bravely pushed its way up the slopes towards the redoubt, and entering the latter, took up its position in action on the open side (towards Krishina), and opened fire.

"The appearance of these guns in the redoubt could not have

been more opportune. The soldiers defending it greeted them with cries of joy; all the more so, as at this moment there were seen advancing on the side of the Krishina redoubt thick chains of skirmishers, quickly succeeded by strong columns, who attacked our left wing. Our men received the enemy with musketry fire; Capt. Vasilieff's half battery opened on them with case shot. The enemy halted at 150 *sagenes* (350 yards) from our position, and beginning to lose heavily, retired. A hundred or so of brave men, with a few officers, rushed from their intrenchments upon the Turks. Received in their turn by a murderous fire, they were obliged to retreat; the Turks, arrived within a thousand paces of our works, lay down, and thick lines of skirmishers kept up a well-sustained fire. Several times the officers (Turkish) vainly endeavoured to make their men get up, and tried to lead them forward.

"The attack was renewed towards 8 a.m., when the enemy had received large reinforcements. Having watched the beginning of the attack, I caused a thick line of skirmishers to descend from the third ridge, and having occupied the Turkish rifle-pits *(gourbis)*, I opened a fire at from 1000 to 1200 paces (by companies in line) upon the flank of the attacking troops.

"In addition, the 5th battery of the 3rd brigade, under Lieut.-Colonel Rouchkovsky was sent by me to the third ridge, from whence it poured in a fire of case shot upon the assailants. In spite of the cross fire of the infantry and twelve guns, the Turks continued advancing with great bravery; but when they arrived at 300 *sagenes* (700 yards) from our intrenchments, they halted, lay down, and continued their fire. Then their reserves, taken in flank, were the first to retire, and soon the whole line retreated likewise. The second attack was repulsed. During this time the defenders of the second redoubt were having a hot skirmish with the enemy's troops who occupied the skirts of the town of Plevna, and advanced under cover of an inequality of the ground to turn our right flank.

"The Turks, repulsed on our right, deployed a strong line of skirmishers in front of redoubt No. 1, and bent their chief efforts upon our position on the third ridge. The fire of their skirmishers, perfectly under cover, soon caused us such severe losses, that I was obliged to send back the 5th battery of the 3rd brigade to remain in reserve until the moment of attack, that is to say, until the time when the enemy should himself unmask his reserves.

"The enemy, convinced of the impossibility of dislodging us from the redoubts by an attack confined to our right flank, and seeing

that our position was very threatening for himself, commenced to move a portion of his reserves towards his centre and left. Towards 10.30 a.m., an energetic attack, undertaken with considerable masses of troops, was directed on redoubt No. 1 by the front and left. At first we defended ourselves most vigorously in the redoubt, but some well-placed shells of the enemy, who was firing on us with two field batteries, killed some dozen of men, and the murderous musketry fire directed on our trenches shook the courage of our soldiers, who had been fighting without stopping for more than thirty hours. Single soldiers, soon followed by small bodies, commenced to leave the redoubt.

"The defenders of No. 2 redoubt seeing No. 1 emptying of its defenders, commenced in their turn to beat a retreat.

"This hesitation lasted but a moment; it was only needful for me to proceed to the head of these blood-stained remnants of our troops, who had covered themselves with glory, to stop these men exhausted by an heroic struggle, and to recal the oath they had sworn to their Sovereign, to make them face about; they again bravely took up their places in the redoubts and trenches.

"All this happened so rapidly that the enemy had not the time to take advantage of this favourable opportunity; he only increased to its utmost limits an already murderous fire.

"Some of the bravest of the Turkish soldiers had already penetrated into the redoubt; they were killed.

"On redoubt No. 1 being re-occupied, the defenders of No. 2 resumed their posts of their own accord. The third attack of the enemy was repulsed.

"On returning to the position I ordered the chief of my staff to reinforce the garrison of the redoubts with some companies of Esthonians, and a combined detachment of the Liebau and Revel regiments. It was impossible to relieve the brave defenders of the redoubt. I had no reserves at my disposal. A few reconnoissances enabled us to make ourselves acquainted with the enemy's positions. Immediately afterwards a made-up company of the chasseurs of the 3rd brigade was sent to reinforce the right wing; it deployed along the Tuchenitsa ravine, and opened fire both upon the enemy's troops who occupied this ravine, and upon those who were intrenched on the road to Plevna and holding it against the 4th corps.

"Then two guns came and took up a position against the reserve troops concealed in the ravine. The enemy, being reinforced, deployed, in his turn, lines of skirmishers along the ravine, overwhelmed

our fire, and took the offensive. The skirmishers commenced to give, and it was only the arrival of two fresh companies of the Liebau regiment (at the commencement of the battle of the 30th August, three companies of this regiment had been partially engaged to the east of the Lovcha-Plevna road, and had suffered little) that was able to restore the battle. The enemy first evacuated the right bank of the ravine, then, under the flanking fire of our artillery and infantry, was obliged to abandon the shelter trenches which he had made on the left bank.

"The enemy's reserve, mentioned above, which was composed of infantry and some hundreds of cavalry, was in consequence obliged to retire on Plevna.

"Our right flank was for some time in safety. The sotnia of the regiment of Ossietines, deployed by me to the left, and in prolongation of the line, co-operated most actively with the chasseurs and the men of Liebau.

" In general, this detachment (two sotnias) of Ossietines, has been throughout the whole campaign a most chivalrous pattern of self-sacrifice and bravery, and its conduct is above all praise.

" Already, during the actions of the 30th August, and immediately after the capture of the redoubts, I had made known that I was unable with the force at my disposal to take advantage of my success, and particularly to take the town of Plevna or the Turkish camp, which I was convinced would have decided the battle; I also earnestly asked for reinforcements.

" On the night of the 30th-31st, I had laid the whole situation before Colonel Orloff, who had been sent to me from headquarters, and I had again implored help, not only to make use of successes already attained, but to be able to maintain the positions which had been carried at the price of so many sacrifices.

" On the morning of the 31st August I received the copy of a despatch from your Excellency to Prince Imeretinsky, conceived in the following terms:—

"' By order of the Commander-in-Chief, I desire you, as well as General Skobeleff, to intrench and maintain yourselves in the positions which you actually occupy until further orders. Do not expect reinforcements, as I have none to send. I await detailed reports of the losses of the 30th August. 'Lieut.-General Zotoff.'

" I, therefore, gave up all hope of being reinforced; nevertheless, the presence of large masses of the 4th corps to the east of the Tuchenitsa ravine, and the elevated position of our right wing, were so threatening for the enemy, that I did not think the game

lost, and considered that an energetic effort on the part of General Kryloff's troops might still snatch victory from the Turks.

"At 10.30 a.m., Colonel Orloff brought me the following order from your Excellency:—

"'By order of the Commander-in-Chief, if you cannot maintain your positions, you are to commence retreating slowly on Tuchenitsa, covering yourself with Leontieff's cavalry, but in any case, as far as is possible, not before the evening. Communicate this order of His Imperial Highness to Prince Imeretinsky. Keep this order a most profound secret. It is very plain to me that you will understand it, and take the necessary steps for carrying it out.

"'The Grivitsa redoubt is in our hands, but we have no means left of continuing the offensive, and it has been decided slowly to withdraw.

"'31st August, 8.30 a.m.' 'General Zotoff.'

"Even after the receipt of this order, I did not despair of a favourable opportunity for us; I, therefore, not only strengthened my front and left flank, as has been explained above, but I made it my object to support the offensive of the 4th corps, which I always looked upon as possible, with my right wing.

"In the meanwhile, the situation of the defenders of the redoubts was becoming more and more difficult. At one in the afternoon, two out of the four guns sent into the redoubt having been dismounted, they were taken to the rear; the officer commanding the detachment (half battery), Capt. Vasilieff, was seriously wounded; the greater part of the gunners and horses of the two last guns had been killed. Therefore, in order to relieve these guns, I ordered Captain Kouropatkina to bring three guns of the 5th battery, 3rd brigade, into No. 1 redoubt. The officer commanding the battery, Lieut-Colonel Rouchkovsky, offered to lead up these three guns. The enemy, seeing the movement, concentrated all his fire on these guns, which arrived in the redoubt after suffering considerable losses both in men and horses. Lieut.-Colonel Rouchkovsky, after having brought his three guns into line by the side of Captain Vasilieff's two last, opened a rapid fire on the Krishina redoubt.

"The ammunition wagon was taken to the only covered place, between the parapet of the redoubt and a traverse. The enemy battered our guns in front by the fire of the Krishina redoubt, and took them in reverse with the fire of the redoubts to the east of the town of Plevna. Soon one-third of the gunners, who were serving their guns with the greatest devotion, and a large number of horses were placed *hors-de-combat*. This was not all: a shell blew up our ammunition wagon; the drivers, all the horses, and a large number of men were killed; Major-General Tebiakina, and Capt. Kouropatkina received contusions.

"At 2 p.m., thanks to the exertions of GeneralPrince Imeretinsky,

who, since the morning of the 31st, had been with his staff within the effective range of both artillery and musketry fire, I received reinforcements in the shape of two weak battalions of Kalouga and a combined battalion of chasseurs of the 11th and 12th battalions, of a strength of about 200 men.

"I directed four companies of Kalouga on the redoubts, three companies to reinforce the troops who were defending the third ridge, three in reserve on the left wing, and finally, I placed the combined battalion of chasseurs under shelter, as much as possible, behind the second ridge.

"These reinforcements arrived most opportunely; large gatherings of troops were visible near the entrenchments of the Krishina redoubt. We soon perceived that these forces were being directed against the left flank of the troops who were occupying the third ridge of the *Montagnes-Vertes*.

"Such a strong deployment of troops forced me to bring the greater portion of my reserves into action. I sent the combined battalion of chasseurs to the left flank; I deployed two companies in skirmishing order, and posted the other two behind the left wing; I reinforced the line with a company, which I hastily made up of the fragments of various regiments, drew in the Kalouga reserves, and finally, brought up four guns into the position, which I caused to be marked with great secrecy. Having made these dispositions, I awaited the attack, which did not delay long in developing itself.

"The enemy, whom we left alone until he came within a good range (500 to 600 paces), advanced vigorously to the front, but then, on receiving the unexpected fire of our skirmishers, and especially of our four guns, halted. The Turks lay down, and their lines opened an exceedingly brisk musketry fire. Their reserves, coming up into line, tried to turn our left, but, swept by our artillery fire, they were compelled to withdraw; after an awful rifle fire, which lasted three-quarters of an hour and caused us considerable losses, their line of skirmishers did the same.

"Fresh endeavours of the enemy to resume the offensive were equally unsuccessful, and we were able to congratulate ourselves with having repulsed the fourth attack.

After this attack, the enemy's musketry and artillery fire began sensibly to diminish.

"This comparative calm did not augur well. I already knew of the failure of the attacks of the 4th and 9th corps, and of the Roumanians, and as all these corps, since the morning of the 31st,

had remained inactive, it was not difficult to foresee that Osman Pasha, being no longer disturbed on his front or his left, would concentrate all his efforts against us, who were occupying a very menacing position, and any fresh success of whom, might result in a complete victory.

"In order to see the assembling of the enemy's troops with my own eyes, I went in the direction of the redoubts. These latter presented (at 3.30 p.m.) a fearful spectacle. Heaps of Turkish and Russian corpses were lying on the ground, and occupied, more particularly, the whole of the *terre-plein*. In the deep ditches connecting the two redoubts the enfilade fire of the enemy was knocking over dozens of men at a time, and the living defenders of these trenches alternated with the dead.

"In No. 2 redoubt, a portion of the parapet, facing the town of Plevna, was formed of dead bodies.

"In redoubt No. 1, the three guns of the 5th battery, 3rd brigade, were smashed to pieces, and no longer had either horses or gunners. The two other guns of the 2nd brigade, no longer having any men to serve them, I ordered to be taken away. The Turkish gun which was left in the redoubt was also dismounted. I ordered the breech block to be carried away, so that the gun, should it fall again into the hands of the Turks, might no longer be of any use.

"I warmly congratulated the brave commanders of the redoubts, Major Gortaloff and Lieutenant-Colonel Mostsevoy, as well as the soldiers, in the name of the Commander-in-Chief, on their heroic resistance.

"From our extreme right we could see with the naked eye large bodies of troops assembling in the camp situated to the rear of the town. Reinforcements were pouring in to these troops from the whole area of the field of battle, and according to the commanders of the two redoubts, the troops from the camp and the Krishina redoubt, after their unsuccessful attack on our left, also proceeded under cover of an irregularity in the ground, in the direction of the camp of Plevna.

"At 2.30 p.m. I was informed of the arrival of a fresh reinforcement, the Schouya regiment; but this reinforcement (about 1300 men) was insufficient. Besides, I did not think it possible to bring the whole Schouya regiment into action at once, in order to relieve the defenders of the redoubt, who were exhausted by a fight of more than thirty hours without a respite. I had no more fresh troops in reserve. Consequently I posted the Schouya regiment in reserve,

and reinforcing the garrisons of the redoubts with a few hundreds of men of all sorts, collected with a great deal of trouble by myself and my brave and indefatigable captain on the staff, Kouropatkina, I tranquilly awaited the commencement of the attack, fully assured of the impossibility of maintaining myself should Osman Pasha direct all the force at his disposal on me, but deeply convinced that the heroic troops who were entrusted to my charge, would spare nothing, and would bring all their energies into play to ensure the general success.

"The attack did not keep us long waiting. At 4.30 p.m., the Turks advanced to the assault in a line of deep columns; one part advanced on redoubt No. 2; another, behind a rise in the ground, on No. 1.

"Received by the fire of our troops, the Turks continued their onward movement, notwithstanding,

"The columns deployed under fire, and partially formed lines of skirmishers, but fresh masses came to carry the first onwards, and the success of the Turks became more and more apparent. Soon, some of the less determined men quitted No. 1 redoubt, and began to descend the slopes. Larger bodies followed them, and the bravest, awaiting the onslaught of the Turks in the redoubt, perished in the unequal conflict.* Amongst them, the hero of this terrible day, Major Gortaloff, was massacred by the enemy.

"Notwithstanding this retreat of the defenders of No. 1 redoubt, Lieutenant-Colonel Mostsevoy continued to defend himself in redoubt No. 2, and never dreamt of evacuating it. After carrying No. 1 redoubt, the Turks advanced with their left wing on redoubt No 2, to facilitate the attack of the neighbouring troops directed against the front and right flank of the redoubt. Not being desirous of leaving these brave men to perish, I advanced to the attack with the Schouya regiment and one battery, and at the same time I sent Lieutenant-Colonel Mostsevoy the order to retreat.

"The general retreat of our troops was covered by the Schouya regiment, which I deployed into line of battle under a most murderous musketry fire.

---

* This is how General Zotoff's report relates the final episode of these bloody battles :— "This order (for the retreat) was correctly executed. Five furious attacks, which the enemy delivered with considerable forces against the troops of General Skobeleff, during the course of the day, were brilliantly repulsed, and when the General, conformably with orders received, commenced his retiring movement on Tuchenitsa in the evening, the enemy did not dare to follow him up, and contented himself with occupying the redoubts, which had been *voluntarily* (dobrovolno) abandoned."

"At 5 o'clock the enemy was master of the two redoubts; in the first, we left in his hands three of our guns very much injured, but without breech blocks, and, in addition, a Turkish gun taken on the 30th August.

"The enemy wished to follow up his offensive movement, but our energetic efforts prevented him. Against those of their men who had slipped in between our weak lines of skirmishers, I sent out a sotnia of Don Cossacks, and the second sotnia of the Vladikavkaz Cossacks. The charge was carried out with the greatest vigour and was completely successful. A great number of Turks were cut down.

"To protect the retreat of the remains of the Vladimir, Souzdal, Revel, Liebau, and Esthonia regiments, and of the battalions of chasseurs, I caused the position on the second ridgé to be reinforced by twenty-four guns, escorted in rear by fragments of the Vladimir, Souzdal, and Revel regiments, and under their protection the whole detachment quietly carried out its retreat, bearing off with it all its wounded.

"As for the wounded of the 30th, and of the battle on the 31st, they had already been carried off.

"On the 1st September we took up a position until the evening on the second ridge, which was fortified as much as possible; then at 7 p.m., in pursuance of orders received, we retired on Bogot.

"The troops confided to my charge have given, during the battles of the 30th and 31st August, a new and brilliant proof of the bravery and unshakeable firmness which characterize our army.

"Both officers and soldiers, incited by the presence of their Sovereign on the field of battle, have performed all that could be expected of them to deprive the enemy of victory. The Turks themselves, according to foreign telegrams, admit that they only succeeded in dislodging us after five furious attacks.

An everlasting memorial to those who fell in this unequal fight! The survivors are happy in the conviction of having well defended the honour of their flag.

"(Signed),

"Lieutenant-General Skobeleff,

"Commander of the Detachment."

There is no mention made in the official reports published in the *Voïennyi Sbornik*, of the losses experienced during these five days of battle. However, a telegram dated from Poradin, 3-15th September, furnishes the following information on this head;—

"According to the reports which have reached Army Head-Quarters up to the evening of the 2-14th September, there have been brought to the dressing stations and field hospitals, from the 26th August to the 7th September, 239 officers, and 9482 soldiers wounded. The number of killed is about 3,000. It is impossible at the present time to give it more exactly. Our total losses are about 300 officers, and 12,500 men. The Roumanian Army has lost up to the morning of the 2-14th September, about 60 officers, and about 3,000 killed and wounded."

The reader has had before him the two detailed reports of General Skobeleff upon the episode of the *Montagnes-Verts*, which will now be completed by the personal observations of his chief of the staff.

Observations on Lieut.-Colonel Kouropatkina, Chief of Lieut.-General Skobeleff's Staff.

"At the time of the attack on the advanced positions to the south of Plevna, on the 9th of September, by General Skobeleff's force, the Kalouga regiment was ordered to occupy the second ridge of the *Montagnes-Verts*. The colonel, called up by the commander of the force, received the necessary instructions. The regiment, formed in the same order as in reserve, was to cross a bare space about 400 *sagenes* (933 yards) in breadth, swept by artillery fire, then cross some hilly ground planted with trees and vines.

"To reach the second ridge of the height it was necessary to traverse nearly a *verst* of country, which, apparently, was not occupied by the enemy. The duty of the regiment was to take possession of the second ridge, and to intrench itself there.

"The regiment advanced in open order, having two of its battalions in the first line, and the third in a second line (each battalion—of the first line—in two lines of company columns, the companies in line, preceded by a thick chain of skirmishers.) The third battalion formed in the same manner followed immediately behind the two first. The regiment thus crossed the open space with the loss of only a few men from the fire of the artillery. Its intrepid colonel rode at its head, eager for the fight, but not seeming to pay much regard either to the most advantageous formations for the attack on account of the peculiarities of the ground, the force and dispositions of the enemy, or to the necessity for holding the greater portion of his regiment in reserve to guard against eventualities.

"Before the regiment could come into action on the wooded heights, the commander of the force directed the colonel to keep one battalion in reserve, and to begin the attack with the two

others, leaving him at the same time his absolute choice of formation to be adopted. At the same time, the general engaged the colonel to remain himself near the special reserve instead of accompanying the line of skirmishers.

"There were two battalions of chasseurs and a second infantry regiment in hand to support the Kalouga regiment if necessary. Unfortunately, instead of contenting himself with a line of skirmishers furnished from a single company, deployed at wide intervals, and supported by two or three other companies, the remainder being held in reserve as far off as possible from the skirmishing line, the commander of the regiment advanced, even when out of sight of the enemy, with his ten companies in a single line of battle, for the order of double line of company columns changes rapidly into single line formation, however little the officers relax their supervision. This results as a natural consequence of the lines of skirmishers slackening the pace, chiefly when exposed to fire; first, the second line arrives at the same height as the first, then both of them finish by melting away into the line of skirmishers.

"The commanders of companies and battalions for the most part prefer to march under fire with the companies deployed. When the ground is broken, and the enemy's fire sharp, the companies soon escape from the hands of their captains, and the battalion commander as soon as all his companies are engaged in the fighting line, finds himself reduced to remain near one or other of them, without having, as most often happens, the means of directing the operations of his battalions.

"The two battalions of Kalouga were advancing thus in a line of little depth, the companies being deployed.

"The enemy just shewed on the other side of the second ridge. The musketry fire began, and continued to increase every minute.

"In conformity with orders received, our battalions halted, and found themselves exposed, in consequence of the order adopted for the attack, to the fire of an enemy who was little visible. The enemy noting our halt, and attributing it to a momentary hesitation, himself passed to the offensive, and threw forward against us a strong line of skirmishers, supported by *Tcherkesses* (irregulars); but being received by a hot fire, the Turks lay down at a short distance from our positions and opened a warm fire. To carry out the mission which was entrusted to the Kalouga regiment, the supports

should have been retired from the fighting line, and sheltered out of sight of the enemy, whilst the line of skirmishers was set to dig trenches. If the enemy, few in numbers as yet, but encouraged by passive behaviour, had approached too near, he might have been repulsed by throwing forward a portion of the troops against him, to make him immediately take up his old positions again.

"Quite another line of action was taken. It is difficult to remain lying down under a heavy fire without returning it. A forward movement is in this case a relief for everyone, this should not be forgotten. Therefore, when the initiative was given by a few officers, and by the soldiers themselves, small scattered groups began to get up, and then the whole line was soon on its feet, and rushed upon the Turks with loud cries of hurrah! The Turks were overthrown, and took to flight.

"The battalions ought to have halted and returned to their former positions; but it was difficult, if not impossible, to restrain them.

"The brave commander of the regiment was contused, whilst the officers allowed themselves to be carried away by the general movement. After driving off the Turks, the two battalions of the Kalouga regiment continued to advance in a very disordered and extended line, the bravest and most active being ahead. Isolated groups of men followed, running in rear. Of ten companies only a few strong parties (*noyaux*), of from 15 to 20 men each, remained together.

"In their pursuit, the Russians overthrew the supports of the Turkish skirmishers, reached the third ridge of the *Montagnes-Vertes*, and commenced to descend the opposite slope. But the Turks had already succeeded in re-uniting on this side considerable forces, and received our men with a destructive fire. The officers sent by General Skobeleff were unable to stop the assailants, and lead them back into the positions above pointed out. Those in rear replied: 'Our men are in front, we must join them;' whilst those in advance, stopped by the heavy fire of the redoubts and intrenchments, had sheltered themselves in a ditch, and were waiting for reinforcements. But soon the Turks taking the offensive attacked in front, and obliged these brave men to retreat.

"The danger was not on our front. The left wing was threatened, and found itself exposed to a very much more serious danger.

"The Turks, horse and foot, made a sortie from the Krishina redoubt, and covered by the ground, fell unexpectedly on the left flank and rear of the Kalouga regiment. The left wing was cut to pieces. The news of this turning movement spread with rapidity.

The retreat became general. The men who had most retained their coolness formed a numerous group, and began to fire upon the Turks, who were pressing them towards the left. All at once someone from this side was heard to cry out distinctly : ' Don't fire, we belong to you !' The soldiers ordered arms, until a volley fired by these *soi-disant* Russians put an end to their doubts, after knocking over several of these too-confiding men.

" Fortunately, the more arduous hours were already past. General Skobeleff caused the first battalion of the Kalouga regiment to advance and deploy, and under its cover a certain amount of order was introduced into the retreat.

" The Turks, encouraged by our retiring movement, rushed forward with loud cries. The battalion of the Kalouga regiment, just come fresh into action, formed line of company columns, and received them with volleys, but could not stop them for long. It became necessary to bring up a battalion of the Esthonia regiment, and to close in two battalions of chasseurs as a reserve.

" These troops, reinforced by the men who did not give way to the retreating movement, succeeded not only in restraining the Turks, but in dislodging them from all the zone which extended as far as the third ridge of the *Montagnes-Vertes*. The second ridge, which was the objective point of this attack, remained in our hands.

" The Kalouga regiment lost nearly 700 men; but such was the spirit of this brave regiment, that the remnants of the two battalions, after having assembled on the position itself, regained the bivouac of the force, singing.

* * * * *

" During the present campaign the Turks have made great use of two principal tactical expedients, viz. : arms capable of being fired with great rapidity, and the fortification of the conjectured site of battle.

" The Turks receive the enemy with a fire opened at distances exceeding 2,000 paces, and cause him to suffer loss.

" The greatest losses are experienced between 2,000 and 600 paces ; after this latter distance, the precision of the fire continually decreases ; the less courageous men cease firing, and the greater part of the others pull the trigger without exposing themselves outside their intrenchments ; the bullets fly in a mass well above the heads of the enemy. The quantity of cartridges with which the Turks are provided is really astonishing. Large boxes of ammunition,

sheathed either with wood or lead, are placed in the trenches, quite independently of the ammunition distributed to the men. Several magazines filled with similar boxes were captured at Lovcha.

"At the time of the attack sustained on the 9th of September by the Esthonia regiment, the Turks advanced to within a very short distance of our intrenchments, lay themselves down, and opened fire. After they had been repulsed, as many as 120 empty cartridges cases were found round the corpses of several of the Ottoman soldiers. On that day (spare) ammunition boxes followed the Turks during their advance. One of our shells exploded one of them to the great delight of our soldiers.

"It may be admitted that the Turks in the battle of Plevna fired from 400 to 500 cartridges per man, in many of the corps, upon the troops of Skobeleff.

"It is difficult to know how often the Turks will be able to show themselves so lavish; at all events, should they persist in their system, they will be unable to do without the enormous supplies of ammunition which come to them from England and America.

"The data relative to the results of our fire in war are limited, as far as regards ourselves, to those deduced from the battles of Lovcha and Plevna. They are, nevertheless, so full of interest that we do not hesitate to reproduce them.

"On the 12th of September, our companies of the line posted upon the third ridge of the *Montagnes-Vertes* directed their fire against the flank of the Turks, who advanced from the Krishina redoubt, upon redoubt No. 1, of which we had made ourselves masters. This fire, delivered at a distance of 1,200 to 1,400 paces, was not wanting in success, chiefly against the Turkish columns.

"On the 11th of September, it was necessary, immediately after the capture of the Turkish redoubts, to repulse an attack made by the enemy's troops, who sortied from the Krishina redoubt and the intrenched camp. Overwhelmed by a hail of bullets, our soldiers at first only replied by a very ineffectual fire. Some fired from behind the parapet of the redoubt without exposing their heads; others fired into the air from the bottom of the ditch. When they had got over their first emotions, and a thick line of skirmishers had been opposed to the assailants, the fire became better regulated, and made the enemy beat a retreat. After chasing the Turks out of the shelter trenches and killing part of them, animated by success, but with an already much diminished strength, we rushed upon the redoubt. This time we were repulsed and obliged to retire, with the Turk

at our heels. In this movement to the rear very few men replied to the enemy's fire; they did not stop even to bring their rifles to the present. Only 20 to 30 men out of 100 returned.

* * * * *

"The second factor in the war, that is to say the fortification of the battle field, suggests the following observations :—

"As soon as the Turks occupy a position they immediately fortify it by means of shelter trenches to hold their skirmishers. If they remain undisturbed, the shelter trenches are deepened, emplacements are made for guns, and finally, open or closed works of considerable relief are constructed. When time permits, traverses (against reverse fire) are added, and the lines of shelter trenches are multiplied according to the conditions of the ground. Besides, the Turks never fail to extend their position by occupying the neighbouring heights which command them. The intrenched camps established at Lovcha and all round Plevna show that there the construction of earthworks was never interrupted. At Lovcha, the position once completely fortified, the Turks constructed several splendid powder magazines, and they began towards the end of this affair to erect blindages (*logements blindés*) for their troops. We did not give them time to finish these last works.

"The comforts with which the Turkish soldiers are surrounded in the trenches are worthy of attention. The interior slopes are provided with holes, in which water and sometimes honey and biscuits are placed for the use of the combatants. A portion of the cartridges are also placed there; the rest of the ammunition remains in the boxes at the bottom of the trenches.

"All the Turkish intrenchments which we captured at Schipka, Lovcha, and Plevna are not only imposing from their size, but they also present an excellent appearance.

"The choice of the positions fortified leaves nothing to be desired. The works at Lovcha and Plevna were unquestionably directed by engineers full of talent and experience.

"Although making their soldiers work in cases of necessity, the Turks preferred to requisition the Bulgarians to construct earthworks. Sometimes the work is paid for.

"Even after a success the Turks do not think of remaining idle. On the 13th of September, the morning following the day on which General Skobeleff was obliged to abandon (after having resisted heroically for 24 hours) the redoubts which he had carried, the Turks were already stirring, and repaired their damages, and destroyed our

shelter trenches. In addition, our chain of outposts, which was sufficiently close to the enemy, could see them distinctly laying out fresh lines of shelter trenches, and working parties commencing their tasks with a will.

"General Skobeleff, who, accompanied by his staff, was examining these works, felt irritated by the tenacity of the Turks, and ordered a gun to be brought up to the outposts. The gun was placed in position by hand, and fired several rounds of case at the working parties. The enemy replied in his turn with some rounds, but the workers dispersed, notwithstanding the efforts of those who were directing them.

"The allowance of tools intended for fortifying the battle field, which our troops have at present at their disposal, is absolutely insufficient against a perfectly sheltered enemy.*

"It is just the same with the *personnel*. The force under Generals Imeretinksy and Skobeleff, comprising a strength of more than 20 battalions, was only accompanied by a detachment of sappers 40 men strong, with one non-commissioned officer.

"And, in the meanwhile, the troops under these Generals were charged with the capture of the intrenched camp of Lovcha, provided with formidable works, and were then to operate below Plevna, at the essential point of the enemy's position upon his right, from whence issues the line of retreat towards Sophia.

"For a company of about 200 men the regulation quantity of field intrenching tools is as follows:—10 shovels, 24 axes, 3 picks, and 3 hoes.

"The number of shovels is very insufficient, if the necessity for breaking ground in each position, as was done by our adversary, be admitted. In order to accelerate the works which were intended to fortify a position, it became necessary to give the tools of an entire regiment to a single company, and even to borrow some from another regiment.

"Let us examine the inconveniences which arise from this.

"At Lovcha, a battalion of the Kagau regiment occupies a height situated exactly opposite the enemy's position, and has to intrench itself there. It was necessary, not only to give it the tools of this regiment, but to have recourse even to those of the Schouya regiment. The same day, two companies of the Revel regiment, told off to construct a 24-gun battery, were obliged to collect the tools of

* At the present time the number of intrenching tools issued to the field army has been considerably increased.

the whole of their regiment. The next morning, at the assault on the Lovcha intrenchments, two battalions of the Kagau regiment, one battalion of the Schouya regiment, and the Revel regiment took part in the fight without their intrenching tools, and gave as an excuse that they had not been returned to them. The battle terminated successfully, and the troops had no need of intrenching themselves; as for the tools, they were found, although with much trouble, on our previous position, when they were made over to those to whom they belonged. A certain number had already been mislaid or rendered unserviceable by these first works.

"On the 9th of September, a battalion of the Esthonia regiment received orders to take possession of the village of Brestovets, and to put it in a state of defence. To carry out this object the battalion was obliged to take the tools of the whole regiment.

"During the evening of the same day, the two other battalions of the regiment were sent to establish themselves on our right, in the vines. It was necessary for them to intrench themselves, and all the pioneers' tools were found to be at Brestovets; they were sent for, but they only turned up two hours before daybreak. Luckily, the trenches were already nearly completed; they were irrigation cuts of considerable size.

"On the 11th of September, the Vladimir regiment was told off to occupy the second ridge of the *Montagnes-Vertes* conjointly with the Esthonia regiment. The quantity of tools which they had at their disposal was so insufficient, that they were obliged to borrow those of the Revel and Souzdal regiments in order to enable them to intrench themselves. Taught this time by the experience of what had happened at Lovcha, the colonels, instead of making over their tools directly to the first two regiments, sent special detachments, taken from the Revel and Souzdal regiments, charged with the duty of bringing back the tools to their respective corps on the completion of the work.

* * * * *

"We have had occasion to see positions which had been, for the most part, thus placed in a state of defence during the night. On inspecting in the morning, very extended lines of shelter trenches are seen, at the bottom of which the soldiers are lying with their rifles resting on the parapets. On careful examination, it is remarked that the trenches are dug with more or less care, according to the degree of anxiety displayed by the subaltern officers; in addition

they afford a more or less perfect shelter according to the character of the soldier who has worked at them.

"If a position placed in a hasty state of defence during the night is not attacked the next day, it is of rare occurrence for a subaltern officer to continue the work intended to strengthen his intrenchments, or to occupy himself with forming the ground (*esplanade*). Usually, everybody waits for this for the orders of their superiors.

* * * * *

"On the 11th of September, the Vladimir, Souzdal, and Esthonia regiments, as well as the third brigade of chasseurs had been established on the third and last ridge of the *Montagnes-Vertes* to prepare the attack on the redoubts; in this position they sustained from 8 a.m. until 3 p.m. a terrible musketry engagement, which inflicted on them enormous losses. The troops, once masters of the ridge, were halted to await the appointed hour of advance (3 o'clock), which was to be the signal for the general assault. During this phase of the fight, the reserves of the Vladimir and Souzdal regiments had only the remains of the intrenching tools available; they were obliged to make the best of them to intrench themselves. The soldiers dug up the ground with their sabres and the covers of their mess tins, and threw the earth out with their hands.

"At 3 p.m., General Skobeleff made his dispositions to attack the enemy's redoubts, and sent on the Vladimir and Souzdal regiments, and the 9th and 10th battalions of chasseurs ahead in the first line; in the second line, the Revel regiment with the 11th and 12th battalions of chasseurs, and behind them the Liebau regiment held itself in readiness to strike the decisive blow. The General placed himself at the heads of the columns. The enemy could not withstand the shock, and the redoubts were carried. It was necessary, without losing a minute, to set about fortifying them on the side nearest the left wing, and to make use of the Turkish trenches; alas! the troops who had reached the redoubts had no intrenching tools, but only a few shovels and axes. And, in the meanwhile, there was the greatest necessity for obtaining shelter from the enemy, who were firing on us from all sides, and whose artillery was taking us obliquely on both flanks. The soldiers themselves recognised this necessity. These brave men dug, or rather scratched the very hard ground with their hands, with bayonets, swords, or mess-tins, threw out the earth with their hands, and sought by every means to make shelter. Everything was put into use to erect parapets; the

branches of the huts which had served as lodging for the enemy, turf, and, in the nearest redoubt to Plevna, even the bodies of the Turks and Russians indiscriminately.

"The night was a little less painful, but the intrenching tools were still wanting on the morning of the 12th of September; the positions, carried at the price of great sacrifices on our part, were nearly in the same condition as when they were taken.

"Notwithstanding the difficulties of the situation, the soldiers, who had made themselves masters of the works, heroically repulsed five furious attacks of the enemy, who had directed all his reserves against the detachment of General Skobeleff, and did not abandon the redoubts until after a twenty-four hours struggle. In the majority of the regiments two-thirds of the strength were *hors-de-combat.*

* * * * *

"In consequence of the considerable losses which we experience in the fights against the Turks, the greater portion of the rifles belonging to the Turks and to the wounded remain on the battle field without being collected.

"Under the most favorable circumstances, a certain number of rifles, already covered with rust, are collected at the end of a few days; in case of a reverse, the arms are abandoned, and fall into the hands of the enemy.

"The litter bearers (Army Hospital Corps) collect the wounded but without their rifles, which worry the latter when lying in the litters.

"It would be a good thing to attach cramps to the litters, on which the rifles might be rested without annoying the wounded, and also to oblige the litter carriers to carry each wounded person to the dressing station with his weapon.

"It would be advisable to attach some men of the artillery to the sanitary stations (field hospitals), having under their orders weak detachments, who would be charged with receiving the arms collected by the litter bearers, and depositing them in a place of safety."

* * * * *

The third attack on the Plevna position, which had been considered for long weeks, and carried on in the most laborious manner by means of regular approaches, and carefully proceeded by four days of a regular bombardment, failed like the two first.

Works, rapidly constructed on the spur of the moment, without

importance from a tactical point of view, had made of Plevna, in the course of a day or so, a position impregnable to open force, a place of the first order. This singular and hitherto unknown fact in the military annals of Europe, these experiences, so often repeated in this campaign, of the impotence of direct attacks against intrenchments, would naturally strike professional men, who soon asked themselves whether hasty fortification, the *ground* itself, were not about to play a predominant *role* in the wars of the future ; whether the spade was not, henceforth, as indispensable an instrument as the rifle, the cannon, and other murderous weapons, which modern industry has placed at the service of the art of destruction.

We have already heard men of talent and experience, but whose natural bias inclines them to scepticism, affirm yet again, with reference to this matter, that the world and human speculation revolve unceasingly in the same circle ; that the present generation should have recourse to the school of Turenne and Montecuculli to learn the art of war, of *positions*, as it used to be carried on more than two centuries ago.

What part do exaggeration and fancy play in these warnings and prophecies ?

Undoubtedly, the Turkish armies had an evident interest in avoiding battles in the open, those great encounters in which the supreme efforts of a whole campaign are concentrated, and where the fate of nations is decided by a single blow; without doubt, the Russian armies may be reproached with having played their adversary's game too much, with not having, perhaps, done everything that was possible to ensure a vigorous impetus to the operations, and, for all these reasons, which are absolutely contingent, one ought not to expect to discover at all in the actual campaign the rapidity, the impetuosity of movement, the lightning like blows which characterize the course of great modern wars. Granted; but it must also be acknowledged that the Russian armies, having resolved to do the same as the German armies in 1870, that is to say, to turn and mask the strong places in order to attack the enemy, yet did not succeed in drawing their adversary into the open ; that their offensive march was stopped, their attempted invasion suspended and paralysed for long months, not by a place of the first-class furnished with a large garrison, but by a poor paltry town, by shelter trenches constructed in haste in extemporised positions. It will be said that the Russian armies should have been able to free themselves more rapidly from this obstacle, and to put the machine in movement again. To this

it will be replied, that the obstacle was quite unassailable by direct attack (*vive force*), that it would have been necessary to manœuvre in order to remove it, and then only to find it again some days later at a few leagues distance; for Osman Pasha's little army carried the invulnerable shield which protected him with it, and did not find it ready to hand at Plevna, although the Romans, those great earth diggers, have left, so they say, the traces of their passage in this region.

May not these unexpected successes of hasty intrenchment (the strategical point of Osman Pasha, resting, according to General Skobeleff, on strictly defensive tactics) be the starting point of a new method of war, or, at least, of a new phase (*jeu*) of the defence? May not this system, as a system, possess some intrinsic value (a deduction from the great inequality of two belligerents in point of organisation and preparedness for war) which would fully justify the nature of it? Such are the principal questions raised by this memorable *incident*, if the purely military consequences of the three successive checks in front of Plevna are put on one side.

Later on, the better informed critic will be able to draw his conclusions, but the controversy is begun, and we cannot allow the Plevna affairs to pass without stating that their issues have raised discussions of the highest order on the questions of tactics and strategy.

Those interested—and at this moment they are numerous, where the responsibility of command is greater than ever—ask themselves anxiously if they are not on the eve of a new evolution in the art of war, and as far as we have got, the attitude of the most competent judges is not sufficiently firm to dissipate all their apprehensions.

Some writers of authority have said in substance—just as the Plevna affair was taking place—that the rapidly firing rifle and the spade may modify the operations of battle, but they cannot prevent energy, a resolute spirit, and aggressive action from always being the first law of war. Osman Pasha's strategic point is all very well, but let us await the end. If Osman Pasha allows himself to be invested, and does not extricate himself in time, he will suffer the fate inevitably ordained for all troops who renounce movement—that is, life. Modern defensive, well-armed as it is, is still only the defensive, or, in other words, only half the task; and if the offensive does not appear at the right time the result is not doubtful. The Turkish armies may continue to avoid great battles, but if this game is continued it will terminate sooner or later in an inevitable catastrophe.

Only one reply can be made to those who held this prophetic language, and that is, that their reasons are good, and they would still be so had Osman Pasha been able to avoid investment and capitulation; had the Turkish armies, instead of declining battles in the open, accepted them, they might have delayed, but could not have prevented the final result, which was only too easy to forsee.

But, if indeed these reasons are full of excellence, they do not on that account exhaust the subject; others still remain.

It would appear proved to-day that a fortified position immediately becomes, with the aid of the modern rifle, and even without the help of cannon, if not quite unassailable by open force, at all events very difficult of being attacked in front. We do not speak, be it understood, of a simple line of trenches, of an isolated redoubt, but of a position in the more extended sense of the word.

Can this fact, which up till now had never before happened, remain without any influence at all upon the conduct of war, or upon the character of future operations?

It is difficult, it is, at all events, imprudent to admit it without examination.

Far be from us, for a single instant, the idea of disregarding the fact, that the aggressive attitude, as we have only just before stated, is the supreme law of war, it's *raison d'être*; that the passive attitude is it's negation, and that the purely defensive may prepare, but cannot procure a decisive solution. We will say, moreover, that it seems to us an erroneous conception that a nation surprised by sudden agression can find its salvation in a passive resistance; it will never find it more than an expedient; the offensive must, as Clausewitz says, at a given moment spring, so to speak, from the very bowels of the defensive itself.

But, however imbued one may be with the justice of these first truths, one is not always ready to accept a decisive battle: reason commands you to *weigh* before *daring*, and more than once you will be obliged to postpone your supreme efforts in order to concentrate them with greater effect. What should be done in such a case? Temporize; but if the enemy is pressing, and he will be all the more so, the better the reasons you have for refusing him battle, you must retire, that is, lose ground in order to gain time. And then, to gain time, without at the same time losing ground, one would be very glad to occupy a fortified position for the moment, which would allow you to present a formal refusal of a decisive battle offered with too much pertinacity. The enemy would be obliged to make you

leave your intrenchments by manœuvres, which might entail certain dangers, and at all events loss of time; he must turn you out, outmanœuvre you (*herauslockern*, *herausmanövriren*), as the Germans say.

It is clear then, from a strategical point of view, that *positions*, nowadays made, if not *invulnerable*, at all events *highly respectable* by the spade and modern rifle, are of a nature to exert an influence upon the conduct of operations. As to their immediate influence upon the field of battle itself it is too self-evident to need any demonstration.

This interesting and sufficiently novel subject has already been sketched, and even fully treated of from the double point of view of tactics and strategy by several foreign reviews; but, without going to the bottom of the subject, the statement can at least be made that the present war brings with it lessons which have an eloquence all their own. In the domain of things appertaining to war, all innovation is, in fact, plausible; it should not, however, be forgotten that new forms, sooner or later, beget corresponding ones in the enemy's camp. To the theory of "strategic points, resting upon simply defensive tactics," facts have already replied in the mournful words of investment and capitulation. The invader, surprised at first by the strategic point, has not delayed to profit by the systematic immobility of the defender to proceed to investment, and then, appealing in his turn to the peculiarities of the defence, has himself also refused battle, and awaited, with grounded arms, for famine, that terrible auxiliary now brought into his game to finish his work for him.

Let us now return to the so-called third battle of Plevna.

The detailed observations which we shall be able to give upon the affair of the "*Montagnes-Vertes*," after those of Lieutenant-Colonel Kouropatkina given above, can only be very brief. But before formulating them, we will ask permission to say a few words about the general conduct of the action, about the *plan* of the battle. The opportunity of doing so is offered us quite naturally by the *orders* or *dispositions* of the commanding officer which accompany the official reports published by the *Voiënnyi Sbornik*. We have given, if not the exact text, at all events the substance of these *dispositions* in the first article upon the third battle of Plevna.*

The directions (*directries*), dispositions, and orders, properly so-

* See page 96 and following, Vol. I., *Occasional Papers*.

called, which express the intentions, resolves, and particular wishes of the commander, are the visible manifestations of his action with regard to the troops, the actual sign of his existence. These three expressions, which are now-a-days generally adopted to indicate and graduate the different tasks of the same directing mind, are tolerably happily chosen. The etymological meaning is already of itself a definition of the thing expressed by the word.

The direction (*la directrie*) contents itself with directing (*diriger*), with tracing in broad outline the conduct to be maintained, with pointing out the *directions* to be followed ; it deals with large masses of troops, or with detachments which are employed on a somewhat independent mission ; it is employed in those situations in which the action of the subordinates allows of a grand initiative, of a large amplitude of movement, without the sphere of immediate contact with the enemy, during marches and operations, or before an expected battle ; it often embraces a period of several days.

The disposition (*la disposition*) arranges, it expresses a more decided, better worked out, and, in some manner, more concrete idea of the commander ; the situations into which it comes into play are already well defined ; the enemy is present, often the battle has commenced, and it is precisely the first period of the engagement which should have furnished the premises for the positive resolutions expressed in the *disposition*, and which will exert a considerable influence, prejudicial or otherwise, upon the course and final issue of the battle. The *disposition* carries out a first redistribution of the troops disposable upon the battle-field, fixes the positions of the groups thus formed, assigns them a part to play, and points out to them the first objective points ; as a rule, it does not go beyond this. The tactical deployment of each of the groups is left to the care of the subordinates ; the hour for coming into line (of battle), and the final and successive objective points will be fixed later on by fresh interference on the part of the commander, and will be promulgated in the form of *orders*.

The *disposition* is the first attempt of the commander to place his hand upon the bulk of disposable troops, and to master, as far as is possible and needful, the direction of a battle, which may up till now be still broken, or more precisely *refused* ; for the battle, properly so called, does not begin until the moment when the commander makes use of (*dispose*) the bulk of his forces.

The *order* is explicit and categorical ; most frequently the hour, the place, the direction, the nature of the prescribed movement are

fixed by the order, and the person receiving it has only to deal with the method of its execution. *Orders*, which are the general's only means of action during the battle itself, are imperative, and require immediate execution, sometimes at all costs (*coûte que coûte*). They nearly always bear an urgent character, which does not appear in the other manifestations of the supreme authority. Again, whilst directions and dispositions are generally drawn up at leisure, orders are nearly always verbal, and are given, as the saying is, in the saddle.

This dissertation upon the *rôle* of commander in the conduct of battle, will, without doubt, appear somewhat theoretical. In practice, things happen otherwise. The action commences as soon as the enemy is felt, it is developed as best it may be, and some difficulty (of the enemy) is awaited or provoked in order to strike a decisive blow. This somewhat too summary synthesis of battle is, in fact, very much spread out, but theory and reason, which are, or ought to be, one and the same thing, evidently ask for more, and this is so true, that in every battle which is not fought unexpectedly, all readers, scoffers, or otherwise, instinctively search the dispositions and orders to discover in them, if possible, the idea itself, the conception of the plan of battle.

This is what we have done with great curiosity with regard to the third battle of Plevna, the least unplanned and the most important of the whole of this campaign. We have read the dispositions signed by the generalissimo and the chief of the staff several times; we heard the reports, *subsequent* to the battle, speak of the *Mon-* were obliged to read them with still greater care when we had *tagnes-Vertes* as the stratego-tactical key of the position, and of General Skobeleff's attack as the decisive attack.

Certainly, *dispositions* do not necessarily contain such important directions, which would of themselves form an entire plan of action. For example, in chance engagements and unexpected battles, the commander is already quite fortunate, in his own estimation, if he has been able to group and redistribute his available forces, to show them their first objective points, to trace out their respective spheres of action, and to detail to each of the groups the special reserves, which appear necessary to him to enable them to fulfil their mission. As soon as he sees what he is about, the commander, from the position where he awaits the decisive moment, keeps his main reserve in hand to take advantage of every local success, wherever it may happen, in order to turn it into victory or

prevent the enemy from doing the like on his side. If the general's calculations are exact, and if they are not counteracted by the enemy or by fortune, the difficulty (*l'incident*), successful or not, will occur at the expected point, and the main reserve will be ready in either case to ensure victory or ward off disasters. If not, it will arrive too late; the victory will be less complete or the defeat more serious.

Let us here remark that the engagement of advanced guards, which should furnish the commander with the necessary indications to enable him to dispose of his main force, is already of itself a battle—that is to say, an action requiring a solution by force of arms. To make sure of the solution, it will be necessary to reinforce the advanced guards—that is to say, to make premature use of the main body, and it will happen, as is so often the case, that the commander-in-chief, instead of simply gaining information, will have battle forced upon him by the engagement of the advanced guards, of which it will only be a continuation, arranged according to circumstances or chance. If the general wishes to keep his main body absolutely intact and available, the action may commence with a check, and he then has only the alternative left of either refusing battle or of going into action without being sufficiently enlightened upon the situation.

There is indeed a very evident expedient; that is to reinforce the advanced guards by troops of the two arms which can be engaged without ceasing to remain available—cavalry and particularly artillery; but this is only an expedient, and it should be well impressed upon the mind, that the general will find himself from the very beginning in these kind of difficulties, which form his normal condition during war, and from which he can only extricate himself by the exercise of tact and firmness of mind.

How much easier is the general's task, when the battle is arranged at leisure in front of an inert and sluggish enemy, when the first period of the engagement, which is so difficult to carry out, is suppressed to make way for the pure and simple preparation of the decisive action, when this preparation is made by the artillery alone, without the necessity for the infantry firing a shot, when the execution, which is reduced to an assault, can take place in the daytime and actually at the appointed hour?

Under these conditions, which are those of the third battle of Plevna, one may expect to find in the disposition for the final act, indications of the decisive point, of the secondary points, of the

principal attack and the demonstrations of attack, and of the *rôle* of the different groups.

We have already said that there is no trace of any preoccupation of this kind in the disposition of the 30th August (11th September). Nowhere is there any question of a decisive attack; the three attacks seem to have the same importance, and the main reserve (*réserve générale*), of weak strength (three regiments), is placed behind the order of battle at an equal distance from the two wings. Although the report of the chief of the staff indicates the *Montagnes-Vertes* as the stratego-tactical key of the position, and Skobeleff's attack, as the decisive attack, there is not a single order, subsequent to the *disposition*, which seems directly inspired with this fundamental idea. If the choice of the chief attack was only made by the Commander-in-Chief on the very day of the assault, then the speech made by a *Times'* correspondant to a Russian officer would only be too well justified. "The third battle of Plevna is a demonstration made with 80 battalions and a decisive attack with 20." But it would not be fair to criticize the report too minutely in this respect, and it seems to us that the idea of making the *Montagnes-Vertes* the decisive attack, is decidedly subsequent to the battle.

The report states the motive of the resolution—taken the 31st August — to abandon Skobeleff's redoubts (the stratego-tactical key) and to keep the Grivitsa redoubt in the following manner. "To keep the three redoubts would have been to extend and weaken beyond measure the front occupied by our troops, which was already weak enough when opposed to the enemy's forces. Consequently it was decided to keep the Grivitsa redoubt, as being situated upon the main road from Sistova to Plevna, and to occupy the two others only until the evening, in order to allow the troops of the detachment time to gain their new position, and then to evacuate them." This explanation does not seem to accord with the *supposed* plan of battle, and it proves, at all events, that the front selected for the attack was too extended for defence, notwithstanding the success obtained on the two wings.

In any case it is probable, as General Skobeleff urges in his report, that a few regiments more placed at his disposal would have enabled him to decide the day. It is a matter of regret that this demand for reinforcement could not be complied with, for, looking at it by the light of principles, the *invulnerability* of the defence, which seems to us somewhat exaggerated, might perhaps have received a serious blow.

Those general reserves, which are so necessary to take advantage of and push a local success, and turn it into victory, were wanting.*

"*Orders* and the redistribution (*disposition*) of the troops for the assault," says Major Boguslawski in his last publication, "should direct the attack upon three points. If they had rested satisfied with two attacks, one of which was *false*, greater solidity and depth could have been given to the disposition for the decisive attack, and there would have been reserves to maintain the positions carried to the south. It may be objected that there are limits to the employment of large masses of troops on a narrow front of attack. Certainly; but in our opinion, skill consists precisely in doing what General Skobeleff did, viz., to reinforce the assaulting troops at the right moment, and then to occupy the captured positions with fresh troops." It must certainly be admitted that General Skobeleff, who had asked in vain for reinforcements, would have had no difficulty in finding them a task or in placing them in position.

With regard to this third battle of Plevna, and generally with regard to all the battles of the campaign, Major Boguslawski makes an observation which cannot have escaped our readers: the frequent and complete mixing up of the fractional parts and units of every description.

It will be well to fight unceasingly against this mixing up, but also without ignoring that it will sometimes be unavoidable; it would then be wise to foresee such events, and to teach the troops to conquer these new difficulties.

There is still another observation of the same author which had already occurred to us, and which we have described as one of the most valuable teachings of this war.

"Actual warfare has again shown that the defence has received, by means of the rapidly firing rifle, an increase of power; but it has also shown that bravely and skilfully conducted attack against a selected objective point is not an impossibility."

The study of this campaign, and more especially the reports now before the reader, will furnish the advocates of long range firing, as well as their adversaries, with favourable arguments

* This is what the report of the chief of the staff has to say on this subject:—"The chief obstacles were surmounted; it only remained to develope the successes already obtained. But for this, at least two fresh divisions would have been necessary, and we had scarcely two whole regiments in reserve; it would have been to expose oneself to great risks to bring these last troops into action, which besides would not have been sufficient to attain their object." Undoubtedly, but as the reserve only consisted of three regiments of infantry, one sees how powerless the commander-in-chief was *a priori* to "develope a success." It is probable that at this moment he would have willingly exchanged two divisions of cavalry for one of infantry.

in support of their contradictory opinions. This was only to be expected. Eye-witnesses acknowleged that the Turks, with their long range firing and their enormous expenditure of cartridges, caused considerable losses to the Russians at a time when the latter could not dream of returning shot for shot, but on the other hand, they agree in stating that the fire of the Turkish infantry became less dangerous after 600 *metres* (656 yards). Is this unfortunate influence of long range firing upon the efficiency of the final fire, that is to say, at easy range in the nature of things, as the advocates of short range firing affirm ; or should it be put down to the indifferent military instruction of the Ottoman troops, as the partisans of long range firing will certainly do ?

In the meanwhile let us call attention to the fact that long range firing, as practised by the Turks, did not once succeed in stopping the offensive movement of their adversaries, nor in hindering them from assaulting, and it is even extremely doubtful if it disorganised and shook them sufficiently to account for the repeated checks in the Russian attacks.

The counter-proof is wanting. The Russian infantry, who are well disciplined and instructed (but little prepared, however, for long range firing) did not make use of both long and short range firing in a like manner. It had a strong and very natural predilection for fire at short distances, and it must be remembered that this fire at short distances was nearly always effective. A very significant example may even be quoted, which is quite a triumph for point blank fire of the defence.

At Tchairkioï, Colonel Sarautcheff ordered his regiment, which was attacked by the Turks, not to fire ; this impassibility, this mournful and ill-omened silence, made such an impression upon the assailants, that the latter, according to Lieut.-General Tatischeff's report, on arriving at 400 paces distance, faced about and took to their heels in the greatest disorder before the Russian regiment had burnt a single cartridge.

A new proof that moral effect, the most powerful factor in war, can in certain cases and against certain troops, set aside all calculations. There can only be this conclusion drawn from this individual and particular case.

Besides, up to this point it does not appear that the Russian infantry, which had to suffer from the power of dispersion of the modern rifle—an illimitable dispersion with slightly instructed troops and unskilful shots—thought of returning the compliment to the

enemy. Admitting that this question could not be gone into during the actual campaign, because the Russian infantry was neither prepared, nor armed to make use of the fire of large masses of men at long ranges, which is now-a-days so much be-praised, yet the idea even has not hitherto made its appearance in those works in which Russian officers, drawing upon the experiences of the war itself, seek to establish conclusions upon the tactics of the future.*

We have just verified the above from the perusal of two tactical studies which appeared together, and side by side, in the *Voiënnyi Sbornik*. In the first, General Leer, honorary professor at the staff college, treats *ab oro* the question of the attack of intrenched positions generally; in the second, Lieutenant-General Heinman applies himself more generally to recommending those operations, the value of which against the actual opponents of the Russian army has just been shown by experience. In these two works, the theory of long range fire by large bodies of troops is nowhere entered upon.

General Leer, taken up chiefly with the necessity for diminishing of losses, reviews all the expedients which have been proposed to this end; after having eliminated *à priori* all those which do not harmonise with essential laws, the nature of battle itself (shields, armour, etc.), he co-ordinates and combines in his regular attack (*attaque méthodique*) those which appear effective and practical, and which are besides quite well known to the reader—the breaking up of the units, open order for the troops not placed in the front line, taking advantage of the ground, zig-zag march, lightening the soldier as much as possible, etc. We have been astonished not to see mentioned in his study a means which has, however, been employed with some success in this war—night attack, and about which General Haneken, in a late number of the *Militär Wochenblatt*, did not think it waste of time to devote a few lines. It should also be remarked that the famous company column no longer figures in the formations for battle of the battalion of the first line, but that it is relegated to the troops of the second line. General Leer and General Heinmann, and many other tacticians, think that

* In the numerous reports published by the *Voiënnyi Sbornik*, we have, however, found an interesting case of long range firing by the Russian infantry. During the fighting in the Schipka Pass, Colonel Lipinsky, who commanded the chief position says:—"That on the 23rd August he made companies of the line, whose rifles are only sighted, as everybody knows, up to 600 yards, fire with success at 1,000 yards; the colonel made them put up the 600 yards sight, but ordered the men to aim at the tops of the trees, which were situated some distance off, between them and the copse in which the Turkish infantry was concealed. The volleys were sufficiently effective to prevent the Turks from showing themselves on the edge of the wood." It was, in fact, a make-shift—indirect fire.

shallow formations, line, open order, skirmishers, are the only ones practicable now-a-days under fire.

The Turkish infantry has, in fact, without knowing it, made an informal trial of the theories put forward by Captain Mieg and by the new regulations for the Prussian infantry fire, without having suggested to its opponents to adopt and bring them to perfection. We must also say that General Heinmann, who writes from the field of battle, recommends the Russian soldier to be as careful of his cartridges as of his spare biscuit (*podobuo soukharion*), and to keep them for the critical moment, and to look upon the Turkish infantry fire as a fire without precision or order. "The Turks, he says, are in the habit of opening a well sustained fire at the longest ranges, seeming to depend more upon the quality of projectiles than upon correctness of aim; it is as well then, in attacks, to stand the enemy's fire without flinching, sheltered by the accidents of the ground—that is to say, to let the enemy fire away his ammunition quite at his leisure, before attacking him."

There is, moreover, more than one stage to get over between the tactics of Suwarrow and that of the fire of masses at long ranges, and when General Leer allows that now-a-days rifle fire at 400 yards is as decisive in its effects as the bayonet charge, this is already a great concession on the part of the Russian tacticians.

PAPER XVII.

A LETTER FROM GENERAL TODLEBEN TO GENERAL BRIALMONT, ON THE

DEFENCE OF PLEVNA,

EXTRACTED FROM THE *Revue Militaire de l'Etranger.*

BY CAPTAIN J. W. SAVAGE, R.E.

THE letter was written in reply to the following :—

"Brussels, 21st December, 1877.

"Dear and Illustrious General,

"Permit me, in my own name and in that of the officers of the Corps which I command, to offer you the warmest congratulations on the capture of Plevna, and on the happy influence which your arrival at the theatre of war exercised. The future has further triumphs in store for you, for the war in the East is not nearly at an end. I need not tell you that our sympathies in this war are not with the barbarous Asiatics, who still allow slavery and polygamy. You will go then to Constantinople, because the interests of civilisation require it. * * * * * The age is past in which a poet was able to say :

"'The trident of Neptune is the sceptre of the world.'

"The Belgian engineers are very anxious to know whether the Turks have progressed in the fortification of battle-fields, and whether you, my dear General, have on your part adopted any new ideas on the defence of positions, and the construction of lines of investment.

"The papers have published plans of Plevna and sketches of the Turkish redoubts, which I have reason to believe are very inaccurate. We hope soon to have from a Russian source more exact and

trustworthy information. The English and French papers have announced at various times that your health has suffered much from the climate of Bulgaria, and from the fatigue which you have undergone. I hope that these reports are much exaggerated, and that you will still continue to render to your country and to the art of the engineer those signal services which have given you so great a name and reputation.

"Rest assured that your friends and admirers, the Belgian engineers, watch your labours with the most lively interest, and vie with your own countrymen in wishing to see them crowned with complete success.

"I will not speak of my country, or of my own labours, seeing that your time is too precious for such small matters, but hope that after the war you will spend some time on the banks of the Rhine or Meuse.

"With feelings of the highest esteem and the sincerest attachment,

"I remain, my dear General, yours, &c.,

(Signed) "A. Brialmont,

"Lieut.-General, and Inspector General of Engineers."

"Brestovets, 6th (18th) January, 1878.

"My Dear General,

"I feel very grateful for your kind letter of the 21st of December, and thank you sincerely for your congratulations and those of the officers of the Belgian engineers on the capture of Plevna. * * * * * I send you herewith a translation of my report to the Grand Duke Nicholas, the Commander-in-Chief of the army; some types of our fortifications, and of those of the enemy; a general plan of Plevna, showing the Turkish intrenched camp, and the fortified positions of our line of investment. As it is the only plan which I possess at present, and that which I used during the blockade, I beg that you will send it back to St. Petersburg for me after you have done with it.

"You are aware that our troops at the commencement approached Plevna simultaneously with the Turks on the 8th (20th) of July, but were repulsed by superior forces; that after that, our adversaries commenced to fortify the positions round Plevna, strengthening them constantly with the greatest activity and energy

during several months. Finally, that we, for our part, tried to take Plevna by assault at all costs, but that the attacks of the 18th (30th) of July and 30th of August (11th of September) were repulsed by the enemy, and cost us 30,000 men.*

"The Turkish positions were very strong, and well supported by numerous reserves placed in the centre of the line of defence. The fire of their infantry threw a hail of bullets to a distance of more than two kilometres.† The most heroic efforts of our troops proved fruitless, and divisions of more than 10,000 men were reduced to an effective strength of between 4,000 and 5,000. The cause of this was that the Turks did not take the trouble to aim, but loaded and fired incessantly from under cover in their trenches. Every Turk had 100 rounds on him, and a box of 500 cartridges by his side; only a few good marksmen were told off to aim at officers.

"The trenches were arranged in many tiers; the redoubts at the most important points had three lines of fire: 1st, from the parapet; 2nd, from the covered way; 3rd, from the escarp, on to a step in which the men hidden in the ditch mounted. The fire of the Turkish infantry produced in this manner the effect of a revolving machine, incessantly throwing masses of lead to great distances. This then was a factor which we were obliged to take into account.

"On my arrival before Plevna in the month of September, our troops and the Roumanians‡ occupied positions on the east and north-east of Plevna, strengthened by some trenches and batteries; the besiegers' infantry held scarcely one-third of the line of circumvallation, and the greater part of the circle could only be watched by cavalry. The Turks kept up their communications with Sophia and Rachova on the left bank of the Vid, and in the direction of Lovcha on the right bank. After having made the necessary reconnaissances, I found that the Turkish positions could not be taken by storm; but that were I in the defender's place I should have been uneasy about the gorge of Plevna and the communications. I demanded a reinforcement (three divisions of the Imperial Guard), therefore, for the investment of the place. All the positions on the right bank of the Vid were immediately occupied by infantry, and fortified; the batteries were given a field of fire of 100 to 120

---

* This number includes the losses of the 8th (20th) July. † About 2,200 yards.

‡ 9th Corps (General Krudener) 12,000 men; 4th Corps (General Zotoff) 18,000; Roumanians 25,000.—Total, 55,000 to 60,000. The Turkish garrison numbered at that time 60,000 to 70,000 men.

degrees, so as to be able to concentrate 60 pieces on each of the enemy's redoubts. The trenches were strengthened by lunettes and redoubts, and along the whole line advances were made towards the Turkish intrenchments by means of approaches and lodgments. Our artillery, consisting of 300 pieces, of which 40 were siege guns, opposed to 100 Turkish pieces, had dismounted some guns. The enemy was obliged to employ his artillery in the most circumspect manner, either by concealing it, or frequently changing its position. Although the Turkish artillery ranged to five kilometres, its effect on us was quite insignificant, the shells rarely bursting. The losses to the garrison caused by our artillery were equally so, only 50 to 60 men daily. The salvoes of our batteries, concentrated suddenly, first on one redoubt and then on another, appeared at first to produce a great moral effect on the enemy, but soon they only achieved the stoppage of work during the daytime.

"The enemy was not slow in taking his own precautions; the garrisons of the redoubts were withdrawn, and placed in trenches at a certain distance from the works; the deep and narrow ditches were alone occupied by the Turks. It need hardly be mentioned that our artillery was powerless against the trenches and ditches. As to the reserves, they were hidden in the folds of the ground, or withdrawn out of range of our artillery. Consequently, the artillery at Plevna played quite a secondary part.

"The essential advantages of the Turkish intrenched camp were as follows:—

"1. The extent of the Turkish position round Plevna was nearly 36 kilometres. *

"2. The configuration of the heights, all radiating from the town, resembles a fan of which Plevna is the centre. The reserves placed in the centre, at a distance of four to five kilometres, could easily support all the threatened points, whilst ravines, increasing in depth as they approached the line of investment, intercepted the communications between the parts of our position.

"3. The fortifications consisted of many rows of defensive lines practically adapted to the ground.

"4. The reserves could be placed out of the range of our artillery.

"5. The fire of the Turkish infantry was shattering and devastating in a degree never hitherto attained by any European army.

"After having made reconnaissances with the cavalry on the left bank of the Vid, towards Telish and Gorni-Dubnik, I ordered

* Rather more than 22 miles.

General Gourko to occupy the Sophia road, and the Roumanians to cross the river above Plevna, in order to cut the enemy's communications with Rachova.

"On the 12th (24th) of October, General Gourko crossed the Vid, and attacked Telish and Gorni-Dubnik with two divisions, and a brigade of Rifles of the Guard.

"At the same time, on the right bank of the Vid, all our batteries opened fire on the entrenched camp of Plevna, and kept it up during the whole day. Three divisions, the 3rd of the Guard, and the 2nd and 16th of the Line, concentrated near the Lovcha road, made a false attack on the Turkish positions, in order to prevent Osman Pacha from assisting the isolated garrisons of Telish and Gorni-Dubnik with the Plevna reserves.

"The villages of Telish and Gorni-Dubnik were fortified by redoubts and shelter trenches, armed with some pieces of artillery.

"The bombardment commenced at 9 a.m. The infantry advanced against Gorni-Dubnik on three sides; the assault was renewed several times; it was only by 8 p.m. that the redoubts and village fell into our hands; the garrison of 4,000 men surrendered.

"Telish resisted during the first day; the garrison of 3,000 men capitulated on the 16th (28th) after a bombardment of some hours' duration.

The obstinate resistance of Gorni-Dubnik is very remarkable; the whole garrison was exposed to the fire of 80 guns, which surrounded the village. The guard attacked with admirable *élan* and impetuosity; they lost 4,000 men; almost every defender, therefore, had placed one of the numerous assailants *hors-de-combat*.

"From the 12th (24th) the investment was complete. The Roumanians had occupied without resistance the villages of Gorni and Dolni-Netropol, situated on the Rachova road. The cavalry had taken possession of all the points of passage of the river Isker.

"All the enemy's communications with the exterior, and above all with Sophia and Rachova, had been broken.

"Up to the 12th (24th) of October, the Turks had received constant supplies of provisions and war material, and sent their sick and wounded to Sophia.

"After that date, the fall of Plevna depended on the quantity of provisions it contained. It remained to take all possible precautions against an attempt by Osman Pacha to break our line of investment, for it was not a question of merely gaining possession of Plevna, but

of making prisoners of Osman Pacha and his army of 50,000 men, composed of Nizams, that is to say, a *corps d'élite*, which could serve as a *cadre* for the formation of a new army.

"Meanwhile, the line of investment had a length of 70 kilometres. Therefore, it was an urgent necessity to have moveable reserves, ready to act, and good roads, so as to be able to concentrate in a short time sufficient force at the threatened points.

"By order of His Imperial Highness, the Commander-in-Chief, on the 4th (16th) of November, two divisions and the brigade of chasseurs of the Guard proceeded by the Sophia road to occupy the passes of the Balkans, and intercept the reinforcement which Osman Pacha was expecting from Sophia. These troops were replaced by the 2nd and 3rd divisions of grenadiers, which had just arrived.

"The left bank of the Vid presenting an open unbroken plain, very favourable to the effects of grazing fire at long distances, it was necessary to establish these fortified positions for the grenadiers at a distance of 3 to 4 kilometres from the Vid, whilst on the right bank of the Vid, on mountainous and broken ground, our lodgments approached to within a few hundred paces of the enemy's positions. The Turks offered an obstinate resistance to all our enterprises and approaches. It was impossible to take them by surprise: to every partial attack they immediately replied with a rolling fire of extreme violence. There was no sign of the least loss of heart amongst them. Deserters were few in number. Nevertheless, from all the reports which had reached me, the Turkish provisions could only last till the middle of December. Winter was approaching, impatience took possession of all minds, the news of the capture of Kars by assault adding to the excitement. Assault was proposed as the only way of finishing Plevna. This I opposed with all the energy inspired by my convictions. Our infantry divisions, which after the assault of the 30th Aug. (11th Sept.) only numbered 4000 to 5000 men, had attained in November, after the arrival of the reserves, the normal strength of 10,000 men.

"The Plevna army of investment was composed as follows:—

4th Corps	2nd, 16th, and 30th divisions
9th Corps	5th, 31st ,,
Corps of Grenadiers—	2nd and 3rd divisions of Grenadiers
Imperial Guard	3rd division of the Guard

"That is—

	Men.	Guns.
8 divisions, of 10,000 men each	80,000	
Besides, 3rd brigade of rifles	4,000	
„ 2 battalions of sappers	1,000	
„ 4 divisions of Roumanians ...	22,000	
Each Russian division had 6 batteries of 8 pieces...		384
Roumanian artillery, 16 batt. of 6 pieces ...		96
2 divisions of cavalry	5,000	
5 batteries of horse artillery, of 6 pieces ...		30
Total,*	112,000	510

"Including gunners, the army comprised nearly 120,000 combatants.

"I had two ends in view :—

"1. To prevent Osman Pasha from getting out, and to oblige him and all his garrison to surrender.

"2. To take care of, preserve, and reinforce our Plevna army, so as to be able after the fall of that place to use it in providing reserves for the other armies, enabling them to take the offensive vigorously.

"In fact, in all our wars with Turkey, the Osmanlis have occasioned us, at the commencement, delays and even disasters, through the obstinate resistance of their fortified places and intrenched camps occupying strategic points—a resistance which has never been sufficiently foreseen.

"In 1828-9, Varna, Silistria, and the entrenched camp of Schumla, baffled all the efforts of our brave army for more than a year. After the capture of Varna and Silistria, the isolation of Schumla, and the first battle gained in the open at Koulefcha, panic seized the Turks—their resistance failed—General Diebitch, notwithstanding the superior forces of the enemy, crossed the Balkans and occupied Adrianople, without encountering any serious resistance : and all this with but 16,000 men, the only remnant of four army corps, decimated by epidemic, exclusive of the troops left to guard our communications.

"My official report to the Grand Duke Nicholas will acquaint you with the details of the taking of Plevna on the 28th Nov. (10th Dec.).

* The 40 siege guns before mentioned are not included in the total.

"Four days after the fall of this place, the troops of the investing army, perfectly husbanded and complete in all particulars, quitted Plevna to assist in the operations of General Gourko on the Sophia road, and of General Radetzky in the direction of Schipka and Kasanlyk.

"You will have learnt by the papers how the army of Suleiman has been dispersed and almost annihilated in the environs of Philipopolis—32,000 men of the Turkish Schipka army taken prisoners, and Adrianople occupied by our troops on the 8th (20th) January.

"After the capitulation of the 28th Nov. (10th Dec.) Osman's army, giving up their rifles, broke up into silent and dignified groups, under the guard of our troops. One hardly recognised in these men the same soldiers who had but so lately offered us such an obstinate resistance. Calm and resigned, they seemed grateful for the least attention bestowed on them. The Turkish officers were unanimous in assuring us that the Plevna army was a *corps d'élite* and that from the moment that they had to lay down their arms the other armies of the Sultan would be incapable of prolonging their resistance.

"When I arrived on the spot, I found Osman Pacha slightly wounded in the leg, and seated in his carriage with his doctor in front of him. In reply to my greeting, he said he had done his best to fulfil his duty, but that all days were not equally lucky. He said that it was, at least, a consolation to him to have been wounded himself.

"Osman is a man of about 45 years of age, of medium height, with an intelligent and even genial look. His behaviour was full of calmness and dignity, and yet never wanting in courtesy. I have twice had the opportunity of conversing with him more at ease. I asked him whether he knew that at the beginning of October we had received reinforcements, threatening his communications even before we passed the Vid. He answered in the affirmative. I then observed to him that I had expected to see him take advantage of that moment to leave Plevna and retire with his army by the Sophia road in the direction of the Balkan passes. He would then have been able not only to save his army, but also to arrest once again the march of ours towards positions certainly not inferior in strength to that of Plevna. Osman replied that at that time he had still abundant provisions; that a premature retreat would have been derogatory to his military honour; and that, besides, he would have

been condemned for it at Constantinople. Moreover, he was rather expecting another decisive assault on our part, which he longed for with all his heart, sure of being able to repel it, whilst at the same time, thanks to the development of his fortifications, inflicting on us even yet greater losses than those we suffered on the 30th and 31st Aug. (11th and 12th Sept.). Under cover of such a victory, he did not doubt the possibility of leaving Plevna before the failure of his provisions.

"It is to Tevfik Pasha, Osman's chief of the staff, that the construction of the fortifications of Plevna is due. When interrogated as to the manner in which he had proceeded, he replied that experience was his only guide.

"It rests with me now to draw a comparison which you will not find devoid of interest. Two entrenched camps have fallen into our hands during the course of this war—Kars, taken by storm, and Plevna, by blockade. In these two cases the same end was attained by essentially different means.

"I send you herewith a very incomplete plan of Kars, published by the *Invalide Russe*. You will see from it that that place is surrounded by 12 forts, of which seven are on the left bank of the Kars-Tchai, on a very elevated plateau, and five are on the right bank. Three of the latter are on the plain and two on well scarped heights. The forts are 2 to 3 kilometres distant from the citadel, which allows the besieger to bombard the town itself and the reserves placed there. The total circumference is 18 kilometres. The greater part of the forts have the character of permanent works, although unprovided with masonry escarps and counterscarps, but having a very strong profile, with bombproof powder magazines and casemated barracks at the gorge. The place was supposed to have a garrison of only 8,000 men, which would certainly not have been sufficient for its defence, considering the extent of the fortifications. The assault commenced at 9 p.m. by the light of a full moon. Twenty-three Russian battalions attacked the forts on the right bank, nine others made serious demonstrations against those on the left bank. At daybreak all the forts on the right bank were ours, as well as the town. A portion of the garrison, principally on the left bank, tried to cut their way out to Erzeroum, but were stopped, thrown back in confusion, and obliged to lay down their arms. 17,000 prisoners were taken (more than double the supposed number of the garrison), 303 guns, and a quantity of provisions.

More than 2,800 of the enemy were buried; 4,500 sick and wounded Turks were found in the hospitals. Our losses were only 487 killed and 1,784 wounded. This extraordinary success cannot be explained, unless by the moral effect produced on both besiegers and besieged by the fact that the army of Mouktar Pacha had just before been completely beaten in open fight, and part of them made prisoners. I suppose, however, that if the first assault had been repulsed, the second would have had no chance of success.

* * * * *

"With unalterable feelings of the highest esteem and of sincere friendship,

"I remain, my dear General, yours, &c.,

(Signed) "Ed. Todleben."

	—	shell of G.S. gauge, and all R.M.L. guns up to the 80-pr. The Mark I. is suited to the 7 and 9-pr. R.M.L. only.
50	—	
50		
82		
50	Divide range by 2, * and add 1.	Painted red.
50	over 1000 add 1.	
50	Divide range by 2, * and add—	
	Up to 1000 1	
44	1000 to 2000 2	
44	2000 to 3000 3	
36	—	
36		
36	—	
36	—	
36	—	Not used in land service.
36		
36		
36	Subtract 6 from the range.*	
36	Subtract 5 from the range.*	
36		
	do.	
24		
24	—	
24		For ranges below 750 yds., double the range plus 10.
19	Add 17 to range.*	
19		
	Add 14 to range *	
16		
13	—	
82	—	
34		

10 the same remark will apply; in the seconds

...

...

...

...

...

high-angle firing when smaller charges are used.

atoms.

ed by

LIST OF SERVICE ORDNANCE A

RIFLED ORDNANCE.

Class of Ordnance.	RIFLED ORDNANCE.	Mark of latest pattern.	ORDNANCE. Service.	Nominal length.	Bore. Calibre.	Bore. Length.	Chamber. Calibre.	Chamber. Length.	Chamber. Capacity.	Average preponderance.	Rifling. Grooves, number.	Rifling. Length.	Rifling. System.	Rifling. Twist	Angle of tangent sights for permanent deflection.	Muzzle velocity.	Energy at 1000 yds.	Energy at 2000 yds.	Piercing power, Iron plates. 1000 yds.	CARRIAGES. Wrought-iron, garrison, sliding, and travelling, without limbers.	PLATFORMS. Wrought-iron, with hydraulic buffer. Casemate.	Dwarf. A.	Dwarf. D.	Dwarf. C.	CHARGE.[n] Battering.	CHARGE.[n] Full, or service.	CHARGE.[n] Reduced.
				f. in.	in.	ft. in.	in.	in.	Cubic in.	tons cwt. qrs.		in.			° ′	f.s.	ft. tons.	ft. tons.	in.	cwt.	cwt.	cwt.	cwt.	cwt.	lb. oz.	lb. oz.	lb. oz.
R.M.L. Armour piercing. 1st	17·72 in. of 100 tons	1.	L.S. & S.S.	32 7.85	17·72	30 3	19·7	55·12	16,637	4 10 2	28	307·88	Polygroove, with driving gas check	1 in 150 cals. at breech to 1 in 50 at 2·88 in. from muzzle, remainder Un.	.....	1542	29070	25605	27·0	.....	...	...	...	...	.....	.....	.....
	16-in.[b] " 80 "	1.	L.S. & S.S.	26 9	16	24 0	18·0	59·6	14,450	Nil.	32	.....	..... "	.....	.....	1520	27160	23890	26·4	.....	...	...	...	...	not settled.	not settled.	.....
	12 5-in. " 38 "	1.	L.S. & S.S.	18 9·5	12·5	16 6	...	...	...	"	9	170·5	Woolwich	I. 0 to 1 in 35 cals.	2 10	1451	9840	8378	17·7	113·75 (garrison).	165·5	cft. recoils	194	193·5	130 0 P.[2w]	100 0 P.[2j]	.....
	12-in. " 35 "	1.	L.S. & S.S.	15 11·75	12	18 6·5	Unchambered.			1 1 0	9	135	..... "	" 0 to 1 in 35 "	1 25	1800	6946	5971	14·8	113 "	...	...	...	185	110 0 P.	85 0 P. or 67 RLG	.....
	" " 25 "	II.	L.S. & S.S.	14 3·5	12	12 1	.....	"	.....	6 0 0	9	127	..... "	" 1 in 100 to 1 in 50 "	0 30	1800	5780	4890	13·1	67 "	110	139·25	142[b]	137·5	85 0 P. or 67 RLG	55 0 P. or 50 "	.....
	11-in " 25 "	II.	L.S. & S.S.	14 2	11	12 1	.....	"	.....	1 2 0	9	119	..... "	" 0 to 1 in 35 "	2 26	1315	5335	4540	13·1	67 "	110	139·25	142[b]	137·5	85 0 " 70 "	60 0 " 40 "	.....
	10-in[1] " 18 "	II.	L.S. & S.S.	14 2·75	10	12 1·5	.....	"	.....	1 0 0	7	118	..... "	" 1 in 100 to 1 in 40 "	1 10	1364	4185	3470	12·0	I. 51·25, II. 67 "	95·5[e]	134·75	141·5	140·5	70 0 " 60 "	44 0 " 40 "	.....
	9-in. " 12 "	V.	L.S. & S.S.	12 3	9	10 5	.....	"	.....	3 0 0	6	104	..... "	" 0 to 1 in 45 "	0 44	1420	2648	2086	9·6	42·25 "	69·5	97·5	103·75	110	50 0 " 43 "	30 0 LG[r] or "	.....
	8-in. " 9 "	III.	L.S. & S.S.	11 4·5	8	9 10	.....	"	.....	3 3 15	4	99·5	..... "	" 0 to 1 in 40 "	0 28	1413	1837	1440	8·25	42·75 (naval).	60, slide	without	hyd[c].	buffer.	35 0 " 30 "	20 0 " "	.....
	7-in. " 7 "	III.	L.S.	11 9·5	7	10 6	.....	"	.....	3 0 0	3	110·5	..... "	U. 1 in 85 cals.	3 0	1540	1331	975	7·2	27·25 (garrison).	58	77·75	81·5	81	30 0 " 22 "	14 0 " "	.....
	" " 6½ "	III.	S.S.	10 6	7	9 3	.....	"	.....	3 3 0	3	95·5	..... "	" 1 in 35 "	3 0	1525	1268	927	7·0	31·25 (naval).	42, slide	without	hyd[c].	buffer.	30 0 " 22 "	14 0 " "	.....
																	Energy of common shell.										
																	At 1000 yds.	At 2000 yds.									
Medium. 4th	7-in. " 90 cwt.	I.	S.S.	10 4·5	7	9 3	.....	"	.....	3 0 0	3	95·5	..... "	" 1 in 85 "	0 44	1250	901	739		25·25 "	40 "	with	"	"	.....	14 0 " "	.....
	8.8-pr.[c] " 5 tons	I.	L.S.	10 0	6·3	9 5·25	.....	"	.....	9 3 4	3	105·25	..... "	" 1 in 40 "	0 19	1240	591	484		.....	...	...	...	...	.....	10 0 " "	.....
	64-pr.[c] " 64 cwt.	I&II	L.S. & S.S.	9 3·5	6·3	8 2	.....	"	.....	8 0 0	3	90·5	Shunt or plain	" 1 in 40 "	2 16	1170	422	336		.....	...	...	...	...	.....	8 0 " "	6 0 LG or
	" [c] " "	III.	L.S. & S.S.	9 3·5	6·3	8 1·5	.....	"	.....	3 3 0	3	90·5	"	" 1 in 40 "	2 50	1383	520	388		.....	...	...	...	...	.....	8 0 " "	6 0 "
	64-pr(8-in)[c] " 71 cwt.	I.	L.S. & S.S.	9 0	6·3	8 7·27	.....	"	.....	6 1 14	3	96·27	Plain groove	" 1 in 40 "	2 16	1230	446	352		.....	...	...	...	...	.....	8 0 " "	6 0 "
	3.4-pr.[c] " 58 "	I.	L.S.	9 6	6·3	9 0·45	.....	"	.....	6 0 0	3	101·45	..... "	" 1 in 40 "	2 16	1245	452	356		.....	...	...	...	...	.....	8 0 " "	...
	64-pr.[c u] " 64 "	III.	L.S. & S.S.	9 3·5	6·8	8 1·5	.....	"	.....	2 2 18	3	90·5	..... "	" 1 in 40 "	2 50	1383	520	388		35 (siege). 49·75[x]	...	...	...	...	.....	10 0 " " [g]	8 0 "
Field and Siege. 5th	40-pr. " 34 "	I.	L.S.	8 0	4·75	7 1·5	.....	"	.....	0 1 0	3	72·5	Woolwich	" 1 in 35 "	1 20	1340	821	246		27 "	...	...	...	...	.....	7 0 " "	.....
	" " 35 "	II.	L.S.	9 6·75	4·75	8 8·5	.....	"	.....	0 0 26	3	90·5	..... "	" 1 in 35 "	1 20	1380	838	253		32·5 " 42·0[x]	...	...	...	...	.....	7 0 " "	.....
	25-pr. " 18 "	I.	L.S.	7 10·5	4	7 4	.....	"	.....	0 0 12	3	73	..... "	" 1 in 35 "	0 53	1320	187	144		15·5 (field). 22·75[x]	...	...	...	...	.....	4 0 " "	.....
																	Energy of common shell.										
																	At 2000 yds.	At 4000 yds.									
	16-pr. " 12 "	I.	L.S.	6 2·45	3·6	5 8·4	.....	"	.....	0 0 7½	3	58·04	French, modified	" 1 in 30 "	1 50	1355	86	33		I. 18·25, II. 12·75 (field).	...	...	...	...	.....	3 0 " "	.....
	13-pr.[b] " 8 "	I.	L.S.	7 3·965	3	7 0	3·15	14·13	110·38	0 0 13	10	67	Polygroove, with driving gas check	I. 0 to 1 in 30 "	.....	1560	...	...		.....	...	...	...	...	.....	.....	.....
	9-pr.[l] " 8 "	I&II	L.S. & S.S.	5 8·5	3	5 3·5	Unchambered.			0 0 7	3	59·8	French, modified	U. 1 in 30 "	1 30	1380	42	24		I. 12·75, II. 11·75 (field).	...	...	...	...	.....	1 12 LG or RLG	.....
	" " 6 "	I.	S.S.	4 10	3	4 5	.....	"	.....	0 1 1½	3	49·3	..... "	" 1 in 30 "	1 30	1234	...	...		.....	...	...	...	...	.....	1 8 " "	.....
	" " 6 "	II.	L.S.	5 11	3	5 6	.....	"	.....	0 0 10	3	62·3	..... "	" 1 in 30 "	1 30	1390	42	25		11·75 (field).	...	...	...	...	.....	1 12 " "	.....
	7-pr. bronze 200 lbs.	II.	S.S.	3 0	3	2 8·15	.....	"	.....	0 2 17	3	29·15	French.	" 1 in 20 "	3 0	914	...	...		.....	...	...	...	...	.....	0 8 PG or RPG	0 4 RSCP
	" steel of 150 "	III.	L.S.	2 2·5	3	2 0	.....	"	.....	0 0 8	3	22	..... "	" 1 in 20 "	3 0	573	...	...		2·73 (mountain).	...	...	...	...	.....	0 6 " "	0 4 "
	" " 200 "	IV.	L.S. & S.S.	3 2·9	3	3 0	.....	"	.....	0 0 5	3	34	..... "	" 1 in 20 "	3 0	963	...	...		3·12 (mountn.) 8·76 (fold Kaffraria)	...	...	...	...	.....	0 12 " [n]	0 4 "
Rifled Howitzers.	10-in.[b] of 6 tons ...	I.	L.S.	6 5·5	10	5 0	.....	"	.....	Nil.	7	.....	..... "	" 1 in 18 "	Vertical.	...	...	...		83·75 (garrison).	...	...	...	96	.....	not settled.	.....
	8-in.[b] of 70 cwt. ...	...	L.S.	9 2·125	8	8 0	8·0	8·0	397	...	24	93·5	Polygroove, with driving gas check	I. 1 in 100 to 1 in 35 "	"	...	...	...		.....	...	...	...	...	.....	.....	.....
	6·6-in.[b] " 36 " ...	...	L.S.	7 4·5	6·6	6 7·2	6·6	5·075	169·5	...	20	76·7	..... "	" " "	...	...	...	...		.....	...	...	...	...	.....	.....	.....
	8-in. " 46 " ...	I.	L.S.	5 1·125	8	4 0	...	...	...	2 0 0	4	35·5	Woolwich	U. 1 in 16 "	"	790	...	...		42·75 (siege).	...	...	...	...	.....	7 10 5 & 2½ lbs. LG or RLG	.....
	6·3-in. " 18 " ...	I.	L.S.	4 6	6·3	3 9	6·3	5·3	161·26	0 0 8	20	42·5	Polygroove, with driving gas check	I. 1 in 100 to 1 in 35 "	"	...	...	...		32·75	...	...	...	...	.....	4, 8, 2, & 1 lb. RLG.	.....
Breech-loading.	7-in. of 82 cwt. ...	...	L.S. & S.S.	10 0	7	8 3·5	7·2	16	...	6 3 16	76	83·125	Polygrooved	U. 1 in 37 cals.	2 16	...	496	350		....	...	...	...	...	.....	11 0 LG or RLG	.....
	" " 72 " ...	...	L.S.	9 10	7	8 1·5	7·2	14·25	...	7 3 27	76	82·875	..... "	" 1 in 37 "	2 16	...	496	350		.....	...	...	...	...	.....	10 0 " "	.....
	40-pr. " 35 " ...	...	L.S. & S.S.	10 1	4·75	8 10·375	4·96	13·5	...	5 1 9	58	92·5	..... "	" 1 in 36½ "	2 16	...	228	161		.....	...	...	...	...	.....	5 0 " "	.....
	" " 32 " ...	...	L.S. & S.S.	10 0	4·75	8 10·375	4·96	13·5	...	4 3 0	56	92·5	..... "	" 1 in 36½ "	2 16	...	228	161		.....	...	...	...	...	.....	5 0 " "	.....
	20-pr. " 16 " ...	...	L.S.	8 0	3·75	7 0	3·94	12	...	2 0 11	44	71·625	..... "	" 1 in 38 "	2 16	...	103	70		.....	...	...	...	...	.....	2 8 " "	.....
	" " 15 " ...	...	S.S.	5 6·125	3·75	4 6·125	3·94	11	...	1 2 0	44	42·75	..... "	" 1 in 38 "	2 16	...	...	...		.....	...	...	...	...	.....	2 6 " "	.....
	" " 13 " ...	...	S.S.	5 6·125	3·75	4 6·125	3·94	11	...	1 1 24	44	42·75	..... "	" 1 in 38 "	2 16	...	...	...		.....	...	...	...	...	.....	2 8 " "	.....
	12-pr. " 8 " ...	...	L.S. & S.S.	6 0	3	5 1·375	3·2	8·5	...	1 3 3	38	52·5	..... "	" 1 in 38 "	2 16	...	59	38		.....	...	...	...	...	.....	1 8 " "	.....
	9-pr. " 6 " ...	...	L.S. & S.S.	5 3	3	4 4·5	3·2	7	...	0 2 26	38	45·5	..... "	" 1 in 38 "	2 16	...	24	19		.....	...	...	...	...	.....	1 2 " "	.....
	6-pr. " 3 " ...	...	L.S. & S.S.	5 0·125	2·5	4 5	2·625	7	...	0 1 27	32	45·625	..... "	" 1 in 30 "	2 16	...	...	...		.....	...	...	...	...	.....	0 12 " "	.....
	Gatling Gun...0·45-in.	Nil.	L.S. & S.S.	4 11·41	0·45	2 7·95	...	...	...	0 1 7	7	28·79	Henry, 10 barrels	" 1 in 22 ins.	Vertical.	...	...	...		5·75 (field) 4 (naval).	...	...	...	...	.....	85 grs. RFG[g]	.....
	" 0·65-in.	...	S.S.	5 2·5	0·65	1 9	...	...	...	.....	...	.....	..... "	.....	.....	...	.....	.....		4 (naval).	...	..	...	...	.....	270	.....

SMOOTH-BORE ORDNANCE.

SMOOTH-BORE ORDNANCE.	ORDNANCE.[l] Service.	Weight.	Length.	Bore. Calibre.	Bore. Length.	Preponderance.	BALLS. Light, ground.	BALLS. Smoke.	CARCASSES (filled.)	CHARGE.[m] Exercising and saluting. Blank, RLG. or L.G.	CHARGE.[m] Service. L.G.	SHELL. Empty. Common.	Empty. Diaph. & rapnel.	Empty. Mortar.	Empty. Naval.	Bursting charge. Common shell, L.G.	Bursting charge. Diaph., shrap. RFG or pistl.	Bursting charge. Mortar, Shell, L.G.	Bursting charge. Naval, Shell, L.G.	Fuzes for Mct. perc. Petmn. General service.	Fuzes for Mct. perc. Petmn. Land service.	Fuzes for Time, wood, Boxer. Common.	Fuzes for Time, wood, Boxer. Diaph., shrap.	Fuzes for Time, wood, Boxer. Mortar. Large.	Fuzes for Time, wood, Boxer. Mortar. Small.	Fuzes for Time, wood, Boxer. M.L.O. 20 secs.	Fuzes for Time, wood, Boxer. M.L.O. 9 secs.	Bold,
		cwt.	ft. in.	in.	ft. in.	cwt.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	drs.	lb. oz.	lb. oz.									
	12-pr.	L.S.	18	6 6	4·698	8 1 21	12 0	12 0	12 0	3 0	12 0	12 0	12 0	12 0	12 0	1 0	1 0	1 0	1 0									
	9-pr.	L.S.	12	6 0	4·2	6 0 0	9 0	9 0	9 0	2 0	9 0	9 0	9 0	9 0	9 0	0 12	0 12	0 12	0 12									
	7-pr.	L.S.	9	5 0	3·3	3 0 0	7 0	7 0	7 0	1 0	7 0	7 0	7 0	7 0	7 0	0 8	0 8	0 8	0 8									
	6-pr.	L.S.	7	4 6	3·0	2 0 0	6 0	6 0	6 0	1 0	6 0	6 0	6 0	6 0	6 0	0 6	0 6	0 6	0 6									
	3-pr.	L.S.	3	3 0	2·5	1 0 0	3 0	3 0	3 0	0 8	3 0	3 0	3 0	3 0	3 0	0 3	0 3	0 3	0 3									
	24-pr. howitzer	L.S.	15	5 0	5·82	6 0 0	12 0	12 0	12 0	3 0	12 0	12 0	12 0	12 0	12 0	1 0	1 0	1 0	1 0									
	12-pr. howitzer	L.S.	10	4 0	4·62	3 0 0	9 0	9 0	9 0	2 0	9 0	9 0	9 0	9 0	9 0	0 12	0 12	0 12	0 12									
	8-in. howitzer	L.S.	9	4 0	8·0	3 0 0	6 0	6 0	6 0	1 0	6 0	6 0	6 0	6 0	6 0	0 8	0 8	0 8	0 8									
	8-in. gun	L.S.	65	15 0	8·0	18 0 0	50 0	50 0	50 0	12 0	50 0	50 0	50 0	50 0	50 0	4 0	4 0	4 0	4 0									
	10-in. gun	L.S.	18	7 0	10·0	35 0 0	100 0	100 0	100 0	25 0	100 0	100 0	100 0	100 0	100 0	8 0	8 0	8 0	8 0									
	12-in. gun	L.S.	25	8 0	12·0	60 0 0	200 0	200 0	200 0	50 0	200 0	200 0	200 0	200 0	200 0	16 0	16 0	16 0	16 0									
	12-in. mortar	L.S.	17	4 0	12·0	10 0 0	200 0	200 0	200 0	50 0	200 0	200 0	200 0	200 0	200 0	16 0	16 0	16 0	16 0									
	13-in. mortar	L.S.	25	5 0	13·0	15 0 0	200 0	200 0	200 0	50 0	200 0	200 0	200 0	200 0	200 0	16 0	16 0	16 0	16 0									
	10-in. mortar	L.S.	12	4 0	10·0	6 0 0	100 0	100 0	100 0	25 0	100 0	100 0	100 0	100 0	100 0	8 0	8 0	8 0	8 0									
	8-in. mortar	L.S.	6	3 0	8·0	2 0 0	50 0	50 0	50 0	12 0	50 0	50 0	50 0	50 0	50 0	4 0	4 0	4 0	4 0									
	5-in. mortar	L.S.	3	2 0	5·0	1 0 0	25 0	25 0	25 0	6 0	25 0	25 0	25 0	25 0	25 0	2 0	2 0	2 0	2 0									
	4·2-in. mortar	L.S.	2	1 8	4·2	0 12 0	12 0	12 0	12 0	3 0	12 0	12 0	12 0	12 0	12 0	1 0	1 0	1 0	1 0									
	3·5-in. mortar	L.S.	1	1 8	3·5	0 6 0	6 0	6 0	6 0	1 0	6 0	6 0	6 0	6 0	6 0	0 8	0 8	0 8	0 8									
	2·5-in. mortar	L.S.	0	15 0	2·5	0 3 0	3 0	3 0	3 0	0 8	3 0	3 0	3 0	3 0	3 0	0 3	0 3	0 3	0 3									

Beech-loading

40-pr.	35	"	...	...	L.S. & S.S.	10	1	4·75	8	10·375	4·96	13·5	...	4	3	0	56	93·5	.....	"	.....	"	1 in 36½	"	2	16	...	228	161	.....	...	...	...	...	.....	...	...	...	...
"	32	"	...	...	L.S. & S.S.	10	0	4·75	8	10·375	4·96	13·5	...	4	3	0	56	93·5	.....	"	.....	"	1 in 36½	"	2	16	...	228	161	.....	...	...	...	...	.....	5	0	"	"
20-pr.	16	"	...	...	L.S.	8	0	3·75	7	0	3·94	12	...	2	0	11	44	71·625	.....	"	.....	"	1 in 38	"	2	16	...	103	70	.....	...	...	...	...	.....	2	8	"	"
"	15	"	...	...	S.S.	5	8·125	3·75	4	6·125	3·94	11	...	1	2	0	44	42·75	.....	"	.....	"	1 in 38	"	2	16	...	...	...	.....	...	...	...	...	.....	2	8	"	"
"	13	"	...	...	S.S.	5	8·125	3·75	4	6·125	3·94	11	...	1	1	24	44	42·75	.....	"	.....	"	1 in 38	"	2	16	...	...	...	.....	...	...	...	...	.....	2	8	"	"
12-pr.	8	"	...	...	L.S. & S.S.	6	0	3	5	1·375	3·2	8·5	...	1	3	3	38	52·6	.....	"	.....	"	1 in 38	"	2	16	...	59	38	.....	...	...	...	...	.....	1	8	"	"
9-pr.	6	"	...	...	L.S. & S.S.	5	2	3	4	4·5	3·2	7	...	0	2	26	38	45·5	.....	"	.....	"	1 in 38	"	2	16	...	24	19	.....	...	...	...	...	.....	1	2	"	"
6-pr.	3	"	...	...	L.S. & S.S.	5	0·125	2·5	4	5	2·625	7	..	0	1	27	32	45·625	.....	"	.....	"	1 in 30	"	2	16	...	...	...	.....	...	...	...	...	.....	0	12	"	"
Gatling Gun...	0·45-in.	Nil.	L.S. & S.S.	4	11·41	0·45	2	7·95	...	...	...	...	...	0	1	7	7	28·79	Henry, 10 barrels	"	1 in 22 ins.	Vertical.	...	...	...	5·75 (field) 4 (naval). 4 (naval).	...	...	...	...	.....	85 grs. RFG² 270	...
"	0·65-in.	"	S.S.	5	5·45	0·65	1	9	...	...	...	...	...	.....	"	.....	"	.....	.....	...	.....	...	...	...	...	.....	...	...	...	...	.....	.....	...

SMOOTH-BORE ORDNANCE.

		Service.	Weight.	Length.	Bore. Calibre.	Bore. Length.	Preponderance.	BALLS. Light, ground.	BALLS. Smoke.	CARCASSES (filled.)	CHARGE.[m] Exercising and saluting. Blank, RLG. or L.G.	CHARGE.[m] Service. L.G.	SHELL. Empty. Common.	SHELL. Empty. Diaph. shrapnel.	SHELL. Empty. Mortar.	SHELL. Empty. Naval.	SHELL. Bursting charge. Common shell, L.G.	SHELL. Bursting charge. Diaph., shrap. RFG or pistl.	SHELL. Bursting charge. Mortar, Shell, L.G.	SHELL. Bursting charge. Naval, Shell, L.G.	SHELL. Fuzes for. Met. perc. Petmn. General service.	SHELL. Fuzes for. Met. perc. Petmn. Lnd service.	SHELL. Fuzes for. Time, wood, Boxer. Common.	SHELL. Fuzes for. Time, wood, Boxer. Diaph., shrap.	SHELL. Fuzes for. Time, wood, Boxer. Mortar. Large.	SHELL. Fuzes for. Time, wood, Boxer. Mortar. Small.	SHELL. Fuzes for. Time, wood, Boxer. M.L.O. 20 secs.	SHELL. Fuzes for. Time, wood, Boxer. M.L.O. 9 secs.
			cwt.	ft. in.	in.	ft. in.	cwt.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.								
Bronze	Guns 12-pr.	L.S.	18	6 6	4·623	6 2½	2·3	.....	.....	9 8	2 0	4 0	8 9	10 3	.....	.....	0 7	24	...	...	.....	C	C.	Sh.	...	...	...	...
	Guns 9-pr.	L.S.	18½	5 11·4	4·2	5 7·74	1·5	.....	.....	.....	1 8	2 8	.....	7 12½	.....	.....	...	18	...	...	.....	...	C.	Sh.	...	...	...	...
	Guns 6-pr.	L.S. & S.S.	6	5 0	3·668	4 9·47	0·75	.....	.....	.....	1 0	1 8	.....	5 0	.....	.....	...	10	...	...	.....	...	C.	Sh.	...	...	...	...
	Guns 3-pr.	L.S.	3	4 0	2·913	3 10	.....	.....	.....	.....	0 12	0 12	.....	.....	.....	.....	...	...	...	...	.....	...	...	...	...	...	...	...
	Guns "	L.S.	2¼	8 0	2·918	2 10	.....	.....	.....	.....	0 10	0 10	.....	.....	.....	.....	...	...	...	...	.....	...	...	...	...	...	...	...
	Howitzers 32-pr.	L.S.	17	5 3	6·3	5 1½	2·0	.....	.....	26 12	2 0	3 0	22 5	28 3	.....	.....	1 5	50	...	...	.....	C	C.	Sh.	...	...	...	...
	Howitzers 24-pr.	L.S & S.S.	12½	4 8·6	5·72	4 7·15	1·0	.....	.....	19 4	1 8	2 8	16 12	21 0	.....	.....	1 0	40	...	...	.....	C	C.	Sh.	...	...	...	...
	Howitzers 12-pr.	L.S & S.S.	6½	3 9·2	4·58	3 7·8	0·5	.....	.....	9 8	1 0	1 4	8 9	10 3	.....	.....	0 7	24	...	...	.....	C	C.	Sh.	...	...	...	...
	Howitzers 4½-in.	S.	2½	1 10	4·52	1 8·86	0·5	.....	.....	9 8	0 4	0 8	8 9	10 3	.....	.....	0 7	24	...	...	.....	C	C.	Sh.	...	...	...	...
	Mortars 5½-in. royal	L.S.	1½	1 3·1	5·62	0 11·94	.....	10 9½	4 8	19 4	.....	0 7	16 12	.....	.....	.....	1 0	...	...	...	.....	...	C	...	...	C[f]	...	...
	Mortars 4⅝-in. coehorn	L.S.	1	1 1	4·52	0 10¼	.....	5 2	2 1	9 8	.....	0 5	8 9	.....	.....	.....	0 7	...	...	...	.....	...	C.	...	...	C[f]	...	...
Cast-iron	Carronades 68-pr.	L.S.	36	5 4	8·05	5 2	2·3	.....	.....	53 0	.....	5 0	47 4	.....	.....	.....	2 9	...	...	...	.....	C	C.	...	...	...	...	...
	Carronades 42-pr.	L.S.	22	4 5	6·84	4 7	1·0	.....	.....	30 8	.....	3 8	29 11	.....	.....	.....	1 12	...	...	...	.....	C	C.	...	...	...	...	...
	Carronades 32-pr.	L.S.	17	3 11·71	6·25	3 11½	0·6	.....	.....	26 12	.....	2 11	22 5	.....	.....	.....	1 5	...	...	...	.....	C	C.	...	...	...	...	...
	Carronades 24-pr.	L.S.	13	3 8	6·68	3 7½	0·3	.....	.....	19 4	.....	2 0	16 12	.....	.....	.....	1 0	...	...	...	.....	C	C.	...	...	...	...	...
	Guns 68-pr.	L.S.	112[o,a]	10 10	8·12	10 3½	10·8	.....	.....	53 0	8 0	18 0	47 4	60 5	.....	.....	2 9	80	...	...	.....	C	C.	Sh.	...	...	...	...
	Guns "	L.S. & S.S.	95[a]	10 0	8·12	9 5·9	10·5	.....	.....	53 0	8 0	16 0	47 4	60 5	.....	47 13	3 9	80	...	2 9	N	C	C.	Sh.	...	...	N	N
	Guns 10-in.	L.S. & S.S.	88[a]	9 4	10·0	9 1·38	9·0	.....	.....	105 0	8 0	12[t] 0	79 4	.....	.....	79 13	6 13	...	...	6 5	N	C	C.	...	...	...	N	N
	Guns 8-in.	L.S. & S.S.	65[b]	9 0	8·05	8 9·27	8·0	.....	.....	53 0	8 0	10 0	47 4	60 5	.....	47 13	2 9	80	...	2 9	N	C	C.	Sh.	...	...	N	N
	Guns "	L.S. & S.S.	60[b]	8 10	8·05	8 7½	6·2	.....	.....	53 0	6 0	10 0	47 4	60 5	.....	47 13	2 9	80	...	2 9	N	C	C.	Sh.	...	...	N	N
	Guns "	L.S. & S.S.	54[a]	8 0	8·05	7 9¾	6·7	.....	.....	53 0	6 0	8 0	47 4	60 5	.....	47 13	2 9	80	...	2 9	N	C	C.	Sh.	...	...	N	N
	Guns 42-pr.[o]	L.S.	84[d]	10 0	6·97	9 6¾	9·0	.....	.....	30 8	6 0	14 0	29 11	37 14	.....	.....	1 12	60	...	...	.....	C	C.	Sh.	...	...	...	...
	Guns "	L.S.	67[a]	9 6	6·935	9 0¾	9·0	.....	.....	30 8	6 0	10 8	29 11	37 14	.....	.....	1 12	50	...	...	.....	C	C.	Sh.	...	...	...	...
	Guns 32-pr.	L.S.	63[b]	9 7	6·41	9 3	5·25	.....	.....	26 12	5 0	10 0	22 5	28 3	.....	.....	1 5	50	...	...	.....	C	C.	Sh.	...	...	...	...
	Guns "	L.S. & S.S.	58[a]	9 6	6·375	9 0·65	6·0	.....	.....	26 12	5 0	10 0	22 5	28 3	.....	22 6	1 5	50	...	1 5	N	C	C.	Sh.	...	...	N	N
	Guns "	L.S. & S.S.	56[c]	9 6	6·41	8 11·2	5·0	.....	.....	26 12	5 0	10 0	22 5	28 3	.....	22 6	1 5	50	...	1 5	N	C	C.	Sh.	...	...	N	N
	Guns "	L.S. & S.S.	50 A[d]	9 0	6·375	8 7·08	7·0	.....	.....	26 12	.....	8 0	22 5	28 3	.....	22 6	1 5	50	...	1 5	N	C	C.	Sh.	...	...	N	N
	Guns "	L.S.	48 or 50[b,c,j]	8 0	6·41	7 7	4·5	.....	.....	28 12	.....	8 0	22 5	28 3	.....	.....	1 5	50	...	...	.....	C	C.	Sh.	...	...	...	...
	Guns "	L.S. & S.S.	45 B[d]	8 6	6·65	8 1½	6·0	.....	.....	26 12	.....	7 0	22 5	28 3	.....	22 6	1 5	50	...	1 5	N	C	C.	Sh.	...	...	N	N
	Guns "	L.S. & S.S.	42 C[d]	8 0	6·35	7 7·2	5·7	.....	.....	26 12	.....	6 0	22 5	28 3	.....	22 6	1 5	50	...	1 5	N	C	C.	Sh.	...	...	N	N
	Guns "	L.S.	40[c,k]	7 6	6·35	7 0¼	3·5	.....	.....	26 12	.....	6 0	22 5	28 3	.....	.....	1 5	50	...	...	.....	C	C.	Sh.	...	...	...	...
	Guns "	L.S.	39[c,c]	7 8	8·375	7 1	3·5	.....	.....	26 12	.....	6 0	22 5	28 3	.....	.....	1 5	50	...	...	.....	C	C.	Sh.	...	...	...	...
	Guns "	L.S. & S.S.	32[c,o]	6 6	6·3	6 0½	3·2	.....	.....	26 12	.....	5 0	22 5	28 3	.....	22 6	1 5	50	...	1 5	N	C	C.	Sh.	...	...	N	N
	Guns "	L.S. & S.S.	25[a]	6 0	6·3	5 7·64	3·5	.....	.....	26 12	.....	4 0	22 5	28 3	.....	22 6	1 5	50	...	1 5	N	C	C.	Sh.	...	...	N	N
	Guns 24-pr.	L.S.	50[g]	9 6	5·823	8 11·41	4·5	... ..	.....	19 4	3 0	8 0	16 12	21 0	.....	.....	1 0	40	...	...	.....	C	C.	Sh.	...	...	...	...
	Guns "	L.S.	48[c]	9 0	5·823	8 5½	4·5	.....	.....	19 4	3 0	8 0	16 12	21 0	.....	.....	1 0	40	...	...	.....	C	C.	Sh.	...	...	...	...
	Guns "	L.S.	20[c,c]	6 0	5·823	5 7½	2·6	.....	.....	19 4	3 0	2 8	16 12	21 0	.....	.....	1 0	40	...	...	.....	C	C.	Sh.	...	...	...	...
	Guns 18-pr.	L.S.	42[c]	9 0	5·292	8 5·75	3·5	.....	.....	14 12	3 0	6 0	12 10	15 15	.....	.....	0 12	30	...	...	.....	C	C.	Sh.	...	...	...	...
	Guns "	L.S.	38[c]	8 0	5·292	7 6	3·5	.....	.....	14 12	3 0	6 0	12 10	15 15	.....	.....	0 12	30	...	...	.....	C	C.	Sh.	...	...	...	...
	Guns 12-pr.	L.S.	34[c]	9 0	4·623	8 6½	3·5	.....	.....	9 8	2 0	4 0	8 9	10 3	.....	.....	0 7	24	...	...	.....	C	C.	Sh.	...	...	...	...
	Guns 9-pr.	L.S. & S.S.	28[a]	8 6	4·2	8 0½	2·7	.....	.....	.....	1 8	3 0	.....	7 12½	.....	.....	...	18	...	...	.....	...	...	Sh.	...	...	...	...
	Howitzers 10-in.	L.S.	42[b]	5 0	10·0	4 9½	5·0	.....	.....	105 0	.....	7 0	79 4	.....	.....	.....	8 12	...	...	...	.....	C	C.	...	...	...	...	...
	Howitzers 8-in.	L.S.	22[b]	4 0	8·0	3 9½	2·5	.....	.....	53 0	.....	4 0	47 4	60 5	.....	.....	2 9	80	...	...	.....	C	C.	Sh.	...	...	...	...
	Mortars 13-in.	L.S. & S.S.	100	4 5	13·0	3 3	.....	.....	.....	234 0	.....	20[i] 0	.....	.....	195 3	.....	...	...	10 16	...	.....	...	...	...	1	...	...	...
	Mortars "	L.S.	36[b]	3 3·65	13·0	2 8·5	.....	.....	.....	234 0	.....	9 0	.....	.....	195 3	.....	...	...	10 15	...	...	...	...	...	1	...	...	...
	Mortars 10-in.	S.S.	52[a]	3 10	10 0	2 11	.....	63 10½	21 3	105 0	.....	9 8	.....	.....	87 2	.....	...	...	5 4	...	.....	...	...	...	1	...	...	...
	Mortars "	L.S.	18[b]	2 5	10·0	2 1	.....	63 10½	21 8	105 0	.....	4 0	.....	.....	87 2	.....	...	...	5 4	...	.....	...	...	...	1	...	...	...
	Mortars 8-in.	L.S.	9[b]	2 1·23	8·0	1 8	.....	33 0	10 12	53 0	.....	2 0	.....	.....	46 1	.....	...	...	2 9	...	.....	...	...	...	1	...	...	...

[a] Dundas's. [b] Millar's. [c] Blomefield's. [d] Monk's. [e] Bored up. [f] Common fuze is to be used when time of flight does not exceed 10″. [g] The weight of shot for bronze guns includes the riveted bottoms.
[h] Dickson. [i] Congreve gun. [j] 100-pr. wrought-iron guns are in the service for coastguard and training ships. Those natures marked with are only retained in the service until replaced by rifled guns.

Copyrighted at the R.E.Institute, Chatham. From the last published by

NANCE AND AMMUNITION. [CORRECTED UP TO MAY 31.] 1878.

PLATFORMS.			CHARGE.[n]			SHELL.								FUZES.							SHOT.		
						Empty.					Bursting charge.			Percussion.			Time.						
																	Metal.	Wood, Boxer.					
Dwarf.			Battering.	Full, or service.	Reduced.	Exercising or saluting. Blank, L.G., or R.L.G.	Common.	Double.	Palliser.	Segment.	Shrapnel, Boxer.	Common. Shell, L.G.	Double. Shell, L.G.	Palliser. Shell, L.G.	Segment. Shell, L.G.	R.F.G. F.G. or pistol.	R.L.	Sensitive.	B.L. plain.	Pettman's, p general service.	Armstrong, E. P.	20 secs.	9 secs.	5 secs.	Case.	Common, solid.	Palliser.
A.	D.	C.																								
cwt.	qr.	cwt.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.									lb. oz.	lb. oz.	lb. oz.
...	...	...	.....	.....	.....	...	.....	...	.....	...	.....	.....	.....	...	.....	...	.....	...	...	...	...	...	...	.....	.....	...
...	...	...	not settled.	not settled.	.....	...	.....	...	.....	...	.....	.....	.....	...	.....	...	.....	...	...	...	...	...	...	.....	.....	...
6n. recoil	1¾	193·5	180 0 P.[gw]	100 0 P.[gj]	.....	...	797 11[x]	...	790 8	...	.....	27 0	.....	11 12	.....	...	.....	...	...	...	...	...	...	738 0[x]	.....	...
...	...	185	110 0 P.	85 0 P. or 67 RLG	.....	...	575 3	...	688 5	...	610 6	40 0	.....	9 14	.....	1 15	.....	...	C.	...	...	Sh.	...	246 0	.....	...
139·25	1½[b]	137·5	85 0 P. or 67 RLG	55 0 P. or 50 „	.....	...	459 6	...	586 4	...	494 18	37 12	.....	14 0	.....	1 15	.....	...	C.	...	...	Sh.	...	246 0	.....	[c]596 4
139·25	1½[b]	137·5	85 0 „ 70 „	60 0 „ „	.....	...	506 4	...	529 8	...	529 10	29 12	.....	8 7	.....	1 12	.....	...	C.	...	...	Sh.	...	200 0	.....	...
134·75	1½·5	140·5	70 0 „ 60 „	44 0 „ 40 „	.....	...	377 12	...	393 8	...	403 0	20 4	.....	6 14	.....	1 9	.....	...	C.	...	...	Sh.	...	143 0	.....	[c]404 0
97·5	1[c]·75	110	50 0 „ 43 „	30 0 LG[c] or „	.....	15 0	230 9	...	244 3	...	264 0	19 0	.....	5 8	.....	1 5	.....	...	C.	...	...	Sh.	...	107 0	.....	[c]246 8
without	hyde.	buffer.	35 0 „ 30 „	20 0 „ „	.....	12 0	166 0	...	174 12	...	179 8	14 8	.....	4 8	.....	1 0	.....	...	C.	...	...	Sh.	...	74 0	.....	[c]176 0
77·75	81·5	81	30 0 „ 23 „	14 0 „ „	.....	...	108 14	145 8	112 1	...	115 10	8 12	10 12	2 8	....	0 12	.....	...	C. D.	...	...	Sh.	...	68 2½	.....	[c]112 0
without	hyde.	buffer.	30 0 „ 22 „	14 0 „ „	.....	10 0	106 14	145 6	112 1	...	115 10	8 12	10 12	2 8	....	0 12	.....	...	C. D.	...	C.	G. Sh. Dble.	...	68 2½	.....	[c]112 0
with	„	„	.....	14 0 „ „	.....	10 0	106 14	...	.....	...	115 10	8 13	.....	...	.....	0 13	.....	...	C.	...	C.	C. Sh.	...	68 2½	.....	...
...	...	...	.....	10 0 „ „	.....	5 0	71 1	...	.....	...	77 8	8 13	.....	...	.....	0 9	C.	...	C.	...	...	Sh.	Sh.	49 14½	.....	...
...	...	...	.....	8 0 „ „	6 Olgorlg	5 0	57 6	...	.....	...	66 0	7 2	.....	...	.....	0 9	C.[r]	...	C.	...	C.	C. Sh.	Sh.[r]	49 14½	.....	...
...	...	...	.....	8 0 „ „	6 0 „ J	5 0	57 6	...	.....	...	66 0	7 2	.....	...	.....	0 9	C.[r]	...	C.	...	C.	C. Sh.	Sh.[r]	49 14½	.....	...
...	...	...	.....	8 0 „ „	6 0 „ J	5 0	57 6	...	.....	...	66 0	7 2	.....	...	.....	0 9	.....	...	C.	...	C.	C. Sh.	...	49 14½	.....	...
...	...	...	.....	8 0 „ „	...	5 0	57 6	...	.....	...	66 0	7 2	.....	...	.....	0 9	C.	...	C.	...	...	Sh.	Sh.	49 14½	.....	...
...	...	...	.....	10 0 „ „ [g]	8 0 „ J	5 0	57 6	...	.....	...	66 0	7 2	.....	...	.....	0 9	C.[r] Sh.	...	...	...	C.	...	C	C. Sh.	Sh.[r]	49 14½	.....	...
...	...	...	.....	7 0 „ „	.....	...	35 9½	...	.....	...	41 9	2 8	.....	...	.....	0 4½	C. Sh.	...	...	...	...	...	C	C. Sh.	Sh.	38 6	.....	...
...	...	...	.....	7 0 „ „	.....	...	85 9½	...	.....	...	41 9	2 8	.....	...	.....	0 4½	C. Sh.	...	...	...	...	...	C	C. Sh.	Sh.	38 6	.....	...
...	...	...	.....	4 0 „ „	.....	...	23 3½	...	.....	...	25 0	1 12	.....	...	.....	0 3	C. Sh.	...	...	...	...	...	C	C. Sh.	Sh.	24 4	.....	...
...	...	...	.....	3 0 „ „	.....	1 8	14 15½	...	.....	...	17 13	1 2	.....	...	.....	0 1½	C. Sh.	...	...	...	...	...	C. Sh.	C. Sh.	15 3	.....	...
...	...	...	.....	.....	.....	...	.....	...	.....	...	.....	.....	.....	...	.....	...	.....	...	...	...	...	...	...	.....	.....	...
...	...	...	.....	1 12 LG or RLG	.....	1 0	8 7½	...	.....	...	9 12	0 7½	.....	...	.....	0 0½	C. Sh.[n]	...	...	...	...	C. Sh.[n]	C.Sh.	9 10½	.....	...
...	...	...	.....	1 8 „ „	.....	1 0	8 7½	...	.....	...	9 12	0 7½	.....	...	.....	0 0½	C.	...	...	...	...	C.	Sh.	9 10½	.....	...
...	...	...	.....	1 12 „ „	.....	1 0	8 7½	...	.....	...	9 12	0 7½	.....	...	.....	0 0½	C. Sh.	...	...	...	...	C. Sh.	C. Sh.	9 10½	.....	...
...	...	...	.....	0 8 FG or RFG	0 4 gorrfg	...	[f]6 14½	11 2½	.....	...	7 9½	0 6½	0 15	...	.....	0 0½	C. Sh.[u]	...	...	...	...	D.	D. C.[v]	Sh.	6 4	.....	...
...	...	...	.....	0 6 „ „	0 4 „	...	[f]6 14½	11 2½	.....	...	7 9½	0 6½	0 15	...	.....	0 0½	C. Sh.	C. D.	...	...	...	D.	D. C.	Sh.	6 4	.....	...
...	...	...	.....	0 12 „ „ [n]	0 4 „	...	[f]6 14½	11 2½	.....	...	7 9½	0 6½	0 15	...	.....	0 0½	C. Sh.[v]	C. D[v]	...	...	...	D.	D. C.[v]	Sh.	6 4	.....	...
...	...	96	.....	not settled.	.....	...	.....	...	.....	...	.....	.....	.....	...	.....	...	.....	...	...	...	...	...	...	.....	.....	...
...	...	...	.....	.....	.....	...	.....	...	.....	...	.....	.....	.....	...	.....	...	.....	...	...	...	...	...	...	.....	.....	...
...	...	...	.....	.....	.....	...	.....	...	.....	...	.....	.....	.....	...	.....	...	.....	...	...	...	...	...	...	.....	.....	...
...	...	...	.....	.....	.....	...	.....	...	.....	...	.....	.....	.....	...	.....	...	.....	...	...	...	...	...	...	.....	.....	...
...	...	...	.....	710 5&2½lbs. LG or RLG	.....	...	166 0	...	.....	...	.....	14 8	.....	...	.....	...	.....	C.	...	...	...	C.	...	74 0	.....	...
...	...	...	.....	4, 3, 2, &1 lb. BL.	.....	...	62 5	...	.....	...	.....	7 0	.....	...	.....	...	.....	C.	...	...	...	C.	...	49 14½	.....	...
...	...	...	.....	11 0 LG or RLG	.....	7 0	{83 0 / 98 0}	...	.....	98 9½	97 0[t]	{6 8 / 7 10}	.....	...	3 2 0	0 8[t]	C. Seg.[r]	...	...	C. Seg.[s]	...	C. Seg.	C. Seg.	...	68 2½	.....	...
...	...	...	.....	10 0 „ „	.....	7 0	98 0	...	.....	98 9½	97 0[t]	7 10	.....	...	3 2 0	0 8[t]	C. Seg.	...	...	C.	...	C.	C. Seg.	...	68 2½	.....	...
...	...	...	.....	5 0 „ „	.....	3 0	37 14	...	.....	38 9½	39 0[r]	2 4	.....	...	0 13 0	0 3[r]	CSeg. Sh.[r]	...	...	C. Seg.[s]	...	C. Seg.	C. Seg. Sh.[r]	...	31 8	40 13½	...
...	...	...	.....	5 0 „ „	.....	3 0	37 14	...	.....	38 9½	39 0[r]	2 4	.....	...	0 13 0	0 3[r]	CSeg. Sh.[r]	...	...	C. Seg.[s]	...	C. Seg.	C. Seg. Sh.[r]	...	31 8	40 13½	...
...	...	...	.....	2 8 „ „	.....	1 8	20 8	...	.....	19 10	.....	1 2	.....	...	700grs.	...	.....	...	C. Seg.	...	...	.....	...	20 5½	20 9½	...
...	...	...	.....	2 8 „ „	.....	1 8	20 8	...	.....	19 10	.....	1 2	.....	...	700 „	Shell, F.G.	.....	...	Seg.	C.	C.	C. ..	...	20 5½	20 9½	...
...	...	...	.....	2 8 „ „	.....	1 8	20 8	...	.....	19 10	.....	1 2	.....	...	700 „		.....	...	Seg.	C.	Seg.	C. ..	...	20 5½	20 9½	...
...	...	...	.....	1 8 „ „	.....	1 0	10 12	...	.....	10 8½	10 11	0 8	.....	...	550 „		0 0½	...	Sh.[r]	...	C.[r]Seg.	...	Seg.	...	Sh.[r]	Sh.[r]	11 8	11 7	...
...	...	...	.....	1 2 „ „	.....	1 0	8 2½	...	.....	8 9½	8 11	0 6	.....	...	300 „		0 0½	...	Sh.[r]	...	C.[r]Seg.	...	Seg.	...	Sh.[r]	Sh.[r]	9 0	8 13	...
...	...	...	.....	0 12 „ „	.....	0 10	.....	...	.....	6 7	.....	.....	.....	...	200 „		.....	...	.....	...	Seg.	...	Seg.	...	...	...	5 9	6 2	...
...	...	...	.....	85 grs. RFG[2]	.....	...	.....	...	.....	...	.....	.....	.....	...	.....	...	.....	...	...	...	...	...	...	.....	480 grs.	...
...	...	...	.....	270	.....	...	.....	...	.....	...	.....	.....	.....	...	.....	...	.....	...	...	...	...	...	...	.....	3 oz. 4 drms	...

Fuzes for								SHOT.			
Mct. perc. Pettman.		Time, wood, Boxer.									
General service.	Land service.	Common.	Diaph., shrap.	Mortar. Large.	Mortar. Small.	M.L.O. 20 secs.	M.L.O. 9 secs.	Solid, loose.	Grape.	Case.	
								lb. oz.	lb. oz.	lb. oz.	
.....	C	C.	Sh.	...	...	...	...	16 16½	.....	12 8	
			Sh.								

[a] Steel barrel. [b] Not yet in the service, but likely to be so. [c] Without gear.
[d] Mark II., 106½. [e] Star shell also used, fuse 6 secs., fired with charge not exceeding 4 ozs. It is issued filled. [f] There is also a 12 lb. charge for exceptional use under certain circumstances with Mark III. 64-prs., 64 cwt., siege guns. [g] Approximate. [h] The length of rifling in B.L. guns includes that in the shot chamber. [i] For S.S. only. [k] This fuse is not used for land service. [l] These guns are not interchangeable, on account of a slight difference in sighting for L.S. and S.S. [m] All cartridges are to be of silk cloth, except the service R.B.L. cartridges, which are serge, and the 7-pr. R.M.L. 4 cs., which is shalloon. [n] The present store of serge cartridges will, however, be used up for charges under 56 lbs. (siege guns and howitzers excepted). [o] L.G. powder to be used until the supply is exhausted with B.L. guns, and in garrison service for all full charges of R.M.L. guns under the 10″, and in the S.S. with R.M.L. guns up to 80-pr. inclusive (7-pr. excepted); the battering charges of R.L.G., and the full charges of h.L.G. 40 lbs. and upwards, are only to be used when P. ganpowder is not available. [p] May be used as shell, their capacity being 7¾ lbs., 4 lbs., 3½ lbs., 2 lbs. 10 oz., and 1 lb. 10 oz., respectively. [q] An 9 cs. charge is used in the navy. [r] The Pettman's G.S. fuse is issued to sea fronts and S.S. only. [s] 7 ft. recoil, 188½ cwt. [t] L.S. only. [u] Not used in seg. in L.S. [v] The 7-in. B.L. shrapnel is not at present in either L.S. or S.S. equipment. [w] Not for Shrapnel in S.S. [x] Not used with D. in S.S. [y] Not yet sealed. [z] With gas check and plug. [1] Maximum charges for 8-in. howitzer. On carriage with wheels 5 lbs., extreme elevation 15°; on bed 10 lbs., extreme elevation 40°. [2] Converted to overbank, including weight of tools.

[3] Take 33-pr. S.B. Ammunition if required.

M.B.-Pr. Gun, mounted on Garrison Carriage and Truck, has been introduced for R.M.L. guns. It is graduated in

| | | |

LIBRARY
1980

TA
1
G72
v.2

Engin
Serials

ENGIN STORAGE

PLEASE DO NOT REMOVE
CARDS OR SLIPS FROM THIS POCKET

UNIVERSITY OF TORONTO LIBRARY

Professional papers of the Corps of Royal Engineers.
Occasional papers